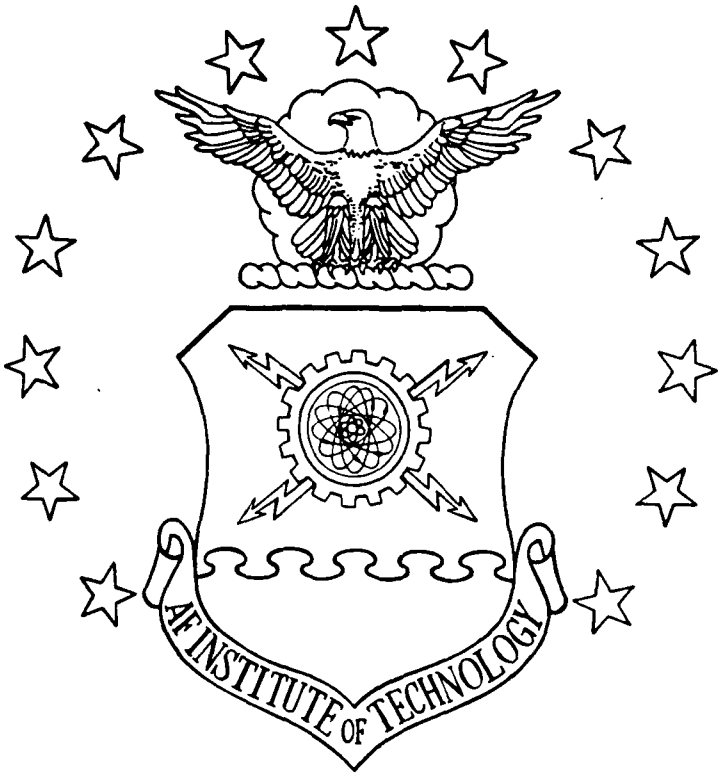

AN ANALYSIS OF THE IMPACTS OF COMPUTER-BASED INFORMATION SYSTEMS ON RESEARCH AND DEVELOPMENT ORGANIZATIONS

THESIS

George H. Sarmiento, Capt, USAF

AFIT/GSM/LSY/89S-33

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

2

AFIT/GSM/LSY/89S-33

AN ANALYSIS OF THE IMPACTS OF COMPUTER-BASED INFORMATION SYSTEMS ON RESEARCH AND DEVELOPMENT ORGANIZATIONS

THESIS

George H. Sarmiento, Capt, USAF

AFIT/GSM/LSY/89S-33

89S

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information is contained therein. Furthermore, the views expressed in the document are those of the author and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

AFIT/GSM/LSY/89S-33

AN ANALYSIS OF THE IMPACTS OF COMPUTER-BASED INFORMATIONS SYSTEMS ON RESEARCH AND DEVELOPMENT ORGANIZATIONS

THESIS

Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University
In Partial fulfillment of the
Requirements for the Degree of
Master of Science in Systems Management

George H. Sarmiento
Captain, USAF

September 1989

Acknowledgments

I would like to thank everyone who helped make this research successful. I would especially like to thank Major Triscari who has guided me throughout this effort. His expertise and support were essential in the completion of this effort.

I would also like to thank Mr Walt Summers and Mr Charlie Bates of the Human Engineering Division for their cooperation and support throughout this research effort. In addition, I would like to thank the other members in the Division who took the time to participate and contribute to the study.

Finally, and most importantly, I would like to thank my wife, Teresa, my daughter, Michelle, and my son, George. During these past 15 months there have been many long days and many long nights to make this research effort possible. It could never have been done without their continued love and support. Thank you.

George H. Sarmiento

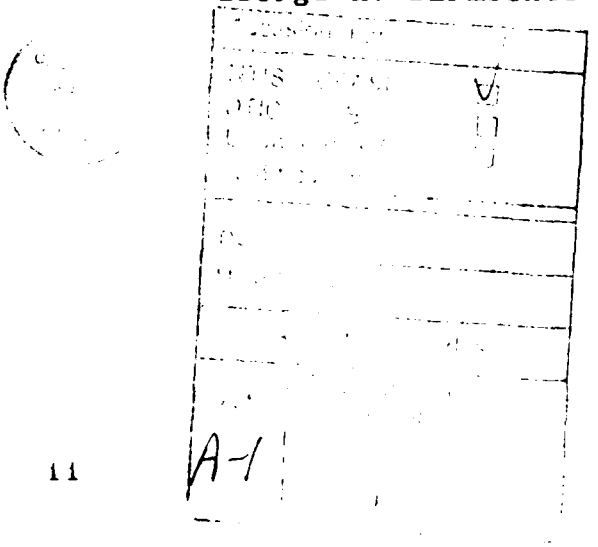

Table of Contents

List of Figures

List of Tables

Abstract

Today, more and more organizations are turning towards computer based information systems to help them deal with the complexities brought on by the Information Society. These computer based information systems are impacting all levels of the organizations.

This research effort was a study involving the impact of a computer based information system at a USAF research and development organization. A key aspect of the study was to attempt to determine if any demographic groups perceived themselves to be impacted by the CBIS more than others.

The results show that a CBIS was perceived by the respondents to impact organizational communication and organizational tasks. Communication within sub-units, between sub-units, and throughout the organization were perceived to be enhanced. In addition, the findings indicate that those members willing to use the system perceived a positive impact on task efficiency and task coordination. Interestingly, the respondents reported that the information system had not reduced their task workload. However, the findings show that the impacts to the organizational hierarchy were mixed. Over 25 percent of the respondents reported bypassing the formal chain of command,

and over 60 percent reported meeting new people through the information system.

The results of this study demonstrate the importance of understanding the theory of organizations as information processors, and some of the potential impacts of computer based information systems in research and development organizations. Most importantly, it is an attempt to identify those groups that may themselves be impacted the most by the information systems.

AN ANALYSIS OF THE IMPACTS OF COMPUTER-BASED INFORMATION SYSTEMS ON RESEARCH AND DEVELOPMENT ORGANIZATIONS

I. Introduction

General Issue

> The unparalleled advances in management information technology in the past half-decade are bringing wholesale changes in organizational form and function unanticipated even a few years ago. Within the seeds of this revolution in technology lies potential for change as potent and ubiquitous as that brought about by changes in manufacturing technologies during the days of the Industrial Revolution. [8:229]

Those words while almost five years old still hold true as computer-based information systems continue to change the way work gets done in today's organizations. The importance of these changes on organizational form and function take on an even greater importance when one considers that more and more organizations are turning to information systems to deal with the technological complexities of modern society.

In fact, a recent survey revealed that the growth rate of computers at all levels of the organization are very high, with the largest increases coming from the microcomputer industry. A set of companies recently studied revealed growth rates from 30 to 100 percent per year (20:70). Computers and computer-based information systems have impacted all levels of the organization, and the future holds more of the same.

To demonstrate this point, a recent survey by Foster and Flynn identified three potential changes to organizational form and function brought on by computer-based information systems (CBIS). They are changes to task performance, changes in the use and purpose of the organizational hierarchy, and a redefinition of organizational communication (8:230). The reason for these changes are clear when discussed in the context of organizations as information processing systems.

Tushman and Nadler have developed a model of information processing as the integrating concept in organizational design. The model is based on the premise that organizations are information processing systems. The model describes organizational effectiveness in terms of matching information processing requirements and information processing capacity. When the two are matched equally, organizational effectiveness (fit) is achieved (24:619).

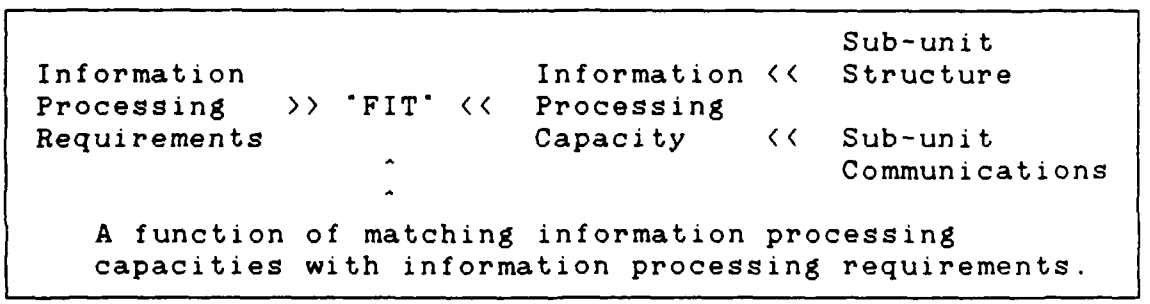

Fig. 1. Adaptation of Tushman and Nadler Information Processing Model (24)

In this model, the information processing capacity of an organization is driven by the organizational structure and the type of communication system used. Thus, when an organization is faced with a change in information processing requirements, the organization must respond with a change to its information processing capacity to maintain fit (24:619).

One method of changing the information processing capacity of an organization is to redesign the communication system. A second possibility is a redesign of the organizational structure. To date most the changes have been on the side of the communication system via a computer based information system. Perhaps the main reason for this is that it may be easier to redesign (or design) a CBIS than redesign the organizational structure and culture. This is because a CBIS is more controllable and costs less to change (12:70).

However, according to Markus and Robey, changing the information system may impact the organizational structure. The reason for this is best explained in terms of what Markus and Robey call **organizational validity** (15:209).

Organizational validity in this case is seen as the degree of fit between the organization's structural characteristics and the information systems design attributes (15:209). In essence, it is the compatibility of the interaction between organizational structure and its

information processing system. These variables in turn impact the information processing capacity of the organization. Thus, unless there is organizational validity, the organization may not be matching its information processing requirements as effectively as possible.

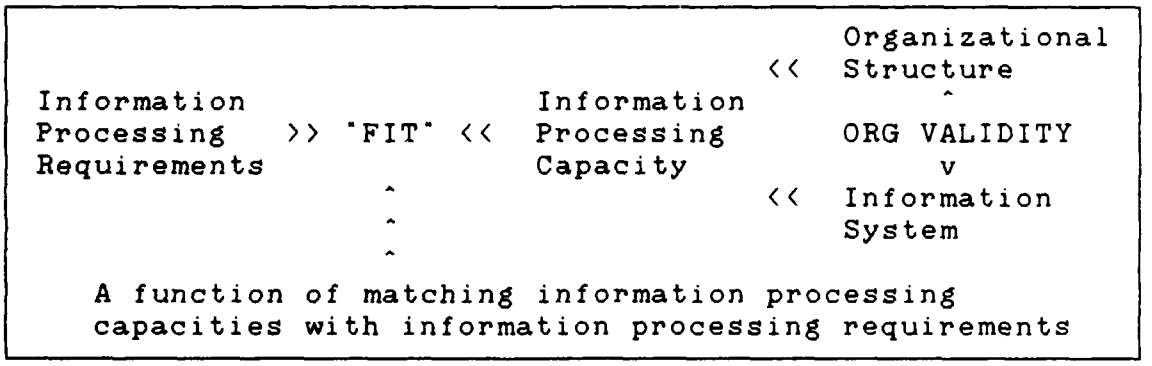

Fig. 2. Adaptation of Information Processing Model Integrating Organizational Validity (24)

Thus with CBIS impacting all levels of the organization, managers more than ever before need to be weary of a mismatch between the information system's attributes and the organization's structural characteristics. Such a mismatch can lead to two possible outcomes, either the CBIS will not be used as intended or the manager will take those steps necessary to correct the mismatch (12:71). In order to correct the mismatch, the first step must be to identify and to understand the impact of the computer-based information system on the organization. Once a manager has identified the impacts of

the CBIS on the organization, then the manager can take the necessary steps to correct that mismatch.

Specific Problem

The focus of this research is to identify the perceived impacts of information systems on organizational form and function. The organizational aspects investigated were the impact of a CBIS on organizational communication, organizational hierarchy, and task performance, within a research and development organization.

A secondary objective was to identify if any groups within this organization were impacted significantly more than others by the CBIS. The goal is to get results that can be used by managers to better modify and/or design information systems that not only fit the organizational structure (validity), but at the same time change the information processing capacity of the unit to match its information processing requirements (fit).

Background

There is very little argument that the U.S. economy is moving towards a service, not product, economy. In fact, almost half of our countries GNP now involves the direct sale of information (17:133). It was this trend that served as the basis for author John Naisbett to declare, in his best-selling book Megatrends, that we are moving towards an

information society. In this society, those organizations with knowledge experts will be the ones to survive. In this society, those organizations with information systems that match their information processing requirements will be the ones to thrive.

Peter F. Drucker, while unable to pinpoint exactly what these organizations will look like, makes it is clear that it will be a more decentralized organization mostly because of the impact of information technology. Drucker compares the future organization to hospitals, universities, and symphony orchestra's, where knowledge experts essentially work independent of each other towards a common organizational goal (6:45). This organizational description resembles today's research and development laboratories.

While information systems have been impacting all levels of the organization, there are certain areas that companies will be investing in more heavily. The four areas of information which will see the biggest investments by organizations in the future will be the elimination of paper, the internal organizational interfaces, the management support, and the external organizational interfaces (25:8).

The elimination of paper, or at least a reduction in paper, through information systems technology is expected to have a major impact on all levels of the organization. The savings come not only from the costs of the paper, but from

the costs of the human labor to create, copy, and transmit the paper.

Another area expected to receive major investment from organizations is the redefining of internal organizational interfaces through an integrated information system. Such a move enhances coordination among the organization's units.

A third area would be the use of information systems by management for support of planning, control and decision making. This includes the use of decision support systems, representative models, or accounting (function) models.

The final area organizations are expected to invest in is external organizational interfaces. The information explosion is creating the need for organizations to stay in closer contact with other organizations. Information systems, along with advances in telecommunications, will allow organizations to meet this need. 'Taken together,' according to Robert Zmud, author of Information Systems in Organizations, 'these (four) developments indicate a technological convergence in the automated communication process in organizations' (25:9).

The information system in this study was intended to meet three out of these four goals. It was intended to reduce paperwork, improve internal communication, and support management control. At the time of the study, the system was not yet interfaced to external organizations.

Justification

> A corporation must consider three factors if it seeks success through information technology. First and second, an understanding of strategic applications and information technology is critical. But a third, and often overlooked, critical dimension is the importance of planning organizational changes that are necessary if strategic applications using information technology are to succeed. [14:3]

This often overlooked aspect of planning organizational changes to insure the success of information technology is the reason for this study. Organizations need to be aware that information technology will have an impact on the organization. These impacts need to be understood by the manager before strategic planning can be done. To do this, one needs to understand the information process within the organization.

In fact, Tushman and Nadler argue that organizations are information processing systems. They claim that the fundamental purpose of organizational design is to organize works units, as well as the linkages between them, in a way that maximizes the organizations ability to collect, process, and distribute information (24:614). Thus, if one accepts that organizations are information processing systems, then it is clear that the technological infusion of a computer based information system will have an impact at all levels of the organization. Indeed, CBIS have the potential to alter organizational communication, hierarchy, and task performance to some degree.

The impact of the CBIS can be understood through the concept of organizational validity. Organizational validity is a generic term that can be applied across various fields. Because it is so generic, it has several advantages in this type of research.

> The term organizational validity implies, first, that a single criterion can be used to assess information systems and, second, that valid systems are more likely to be easily implemented and effectively used. [15:205]

Markus and Robey point out four types of organizational validity. The four types are user-system fit, organization structure-system fit, power distribution fit, and environment-system fit (15:205). This research effort will deal with the organization structure-system fit.

When talking about degree of fit, the two key structural characteristics are the type of organizational structure (mechanistic versus organic) and the degree to which decisions are centralized or decentralized. It is the match of the CBIS to these two characteristics of structure that will determine organizational validity. Thus as Robey emphasizes, the key point is not whether a CBIS will work in a certain organization, but whether the CBIS **matches** the organization's structural characteristics. If it does not match, action needs to be taken by the manager to correct the mismatch or suffer the consequences of the CBIS not being used as intended (12:71). The first step in identifying a mismatch is identifying and understanding the

effects of the computer-based information system on organizational communication (function), organizational tasks (function), and organizational hierarchy (form).

Scope of Research

Markus and Robey clearly point out that the effects of computer-based information systems on organizations can be viewed from at least four different perspectives. This research concentrated on the organizational structure-system fit. The organizational aspects examined were the impacts of the CBIS on organizational communication, organizational hierarchy, and task performance.

Specifically, it was a study dealing with the impact of a distributed CBIS on the Human Engineering (HE) Division located at Wright-Patterson Air Force Base, Ohio. A **distributed CBIS** is one in which each computer terminal has its own processing capabilities, but can only communicate with other computer terminals by going through a central processor (12:64). Currently the distributed CBIS at HE Division has been in place for two years.

This organization was chosen because the distributed system was operational, providing personnel the ability to work at their own station, get support from the Division through the mainframe when they need it, and communicate when necessary from terminal to terminal. It is a decentralized information system matching the decentralized structure of the HE Division. Subsequently, with a well

matched CBIS, the CBIS impacts on the organizational structure should be minimal.

The organization itself contains 94 government personnel divided into 7 Branches with one Division Chief. There is one Branch that is a Division-wide support Branch, four Branches that are the main technical branches, and two other Branches that are more project oriented than research oriented. Note that from this point on, the term branch and sub-unit will be used interchangeably.

There are also approximately 90 on-site contractors. These contractor's have offices within the HE Division. The contractor's role is to support the government's technical research.

While the impacts of CBIS on mechanistic structures are important, this area has been intensely investigated and reported in the literature. This is probably due to the fact that a CBIS impact would be more apparent in a mechanistic-type organization, and that mechanistic-type organizations are still the norm today. However, the trend today is to cut management layers and to move towards organic-type organizations; that is organizations which tend to be more decentralized.

It is this trend that encouraged the researcher to examine an organization that resembles the organization of the future, a research and development laboratory. The results of this research then will not only benefit

laboratory managers throughout the USAF today, but it may, if you believe Drucker, be more relevant to organizations of the future.

Research Questions

The research questions used to guide this research were based on three facets of the organization. The three aspects were organizational communication, organizational tasks, and organizational hierarchy. Each question examined the attitudes and perceptions of the employees of the HE Division.

1. Does an apparently well "fit" CBIS impact an organic-type structure like that of a research and development organization?

2. What impact does a CBIS have on organizational communication in terms of direction, inter and intra sub-unit communications, and task-related content?

3. What impact does a CBIS have on organizational tasks in terms of efficiency, coordination and workload?

4. What impact does a CBIS have on organizational hierarchy in terms of the formal chain of command and the development of informal groups and networks that cross organizational boundaries?

5. Have any identifiable groups within the organization been impacted by the CBIS more than others?

Definition of Terms

The following terms will be used extensively throughout this research effort. They are presented here to clarify their meaning within the context of this research effort.

1. Information processing : refers to the gathering, interpreting, and synthesis of information in the context of organizational decision making (24:614).

2. Organizational validity : refers to the match between the structural characteristics of the organization and the different information system design attributes. It is a property of neither the organization nor the system, but of the match between them (15:205-209).

3. Mechanistic organization : characterized by centralization of control and authority, vertical lines of communications, and many rules and procedures (3:298).

4. Organic organization : characterized by decentralization of control and authority, horizontal lines of communication more pervasive than vertical lines of communication, and few rules and procedures (3:298).

5. Distributed CBIS - ones in which each computer terminal has its own processing capabilities, but can only communicate with other computer terminals by going through a central processor (12:64).

Chapter Summary

This chapter presented evidence that we are living in an information society where organizations should be viewed as information processors. In order to meet their information processing requirements, many organizations are turning to computer based information systems. These computer based information systems are impacting all levels of the organization.

The three organizational facets investigated in this case study are organizational communication, organizational hierarchy, and task performance. A research and development laboratory was chosen for the case study because its organic

organizational structure closely resembles the trend of future organizations. This particular research and development laboratory, the Human Engineering Division, was chosen because it had recently implemented a distributed CBIS that appears to closely match its decentralized organizational structure. The goals of the CBIS system were to reduce paperwork, improve internal interfaces, and support management control.

II. Literature Review

Overview

This chapter is divided into three sections. The first section reviews the concept of organizations as information processors. The second section reviews the current literature on information systems and their impact on organizations. The third section reviews the Foster and Flynn study, "Management Information Technology: Its Effects on Organizational Function and Form." The Foster and Flynn study served as the basis for this effort's research design.

Organizations as Information Processors

The concept of organizations as information processors has it roots in **systems theory**. The concept is based on the view of organizations as open-ended systems that monitor and react to the environment. As information processors, the organization receives information, transforms it, and then outputs information to meet its information requirements.

According to Allen's research, the input to technical organizations is usually in terms of verbally encoded information (papers and discussion). The output can either be physically encoded information (hardware and other products) or verbally encoded information, or both. If this concept is extended to sub-units, then within a unit, the output of one stage becomes the input for another (1:3).

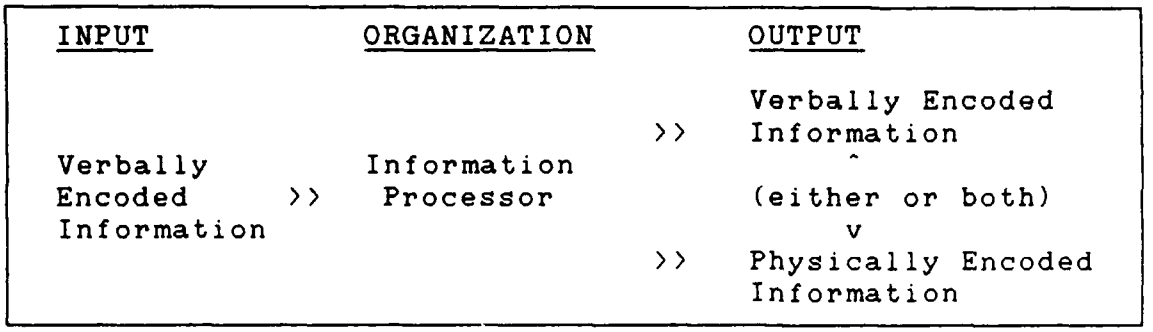

Fig. 3. Adaptation of Allen's Information Flow in Science and Technology (1)

Thus, the organization is viewed as a "set of networks, filters, and channels for processing information" (21:5). The organization than strives to "create the most appropriate configuration of work units (as well as the linkages between them) to facilitate the effective collection, processing, and distribution of information" (24:614). This configuration drives the information capacity of the organization that is used to meet its information requirements.

In this context, information is seen as "data that is meaningful to the recipient" (5:9). It is considered to be any bit of data that effects a change to the recipient. Thus, the goal of the organization as an information processor becomes the "gathering,interpreting, and synthesis of information in the context of organizational decision making" (24:614). It is in this context, organizational decision making, that makes information processing so important to the organization.

> Decisions require information, which flows to decision makers from various parts of the organization and from the environment in which the organization operates. The results of decisions are communicated in the reverse direction to promote action throughout the organization. Therefore communication of information from one place in the organization to another can be taken as the critical factor in the achievement of the organization's goals, and organizational structure should aim to facilitate decision making. Without information, there is no basis for decision making. [9:39]

This line of thinking taken by Forrestor stands as further support for Tushman and Nadler's model of the organization as an information processor. It clearly points out, as do Tushman and Nadler, that the organization's ability to respond to information requirements (information capacity) is dependent upon its sub-unit structure and its sub-unit communication channels.

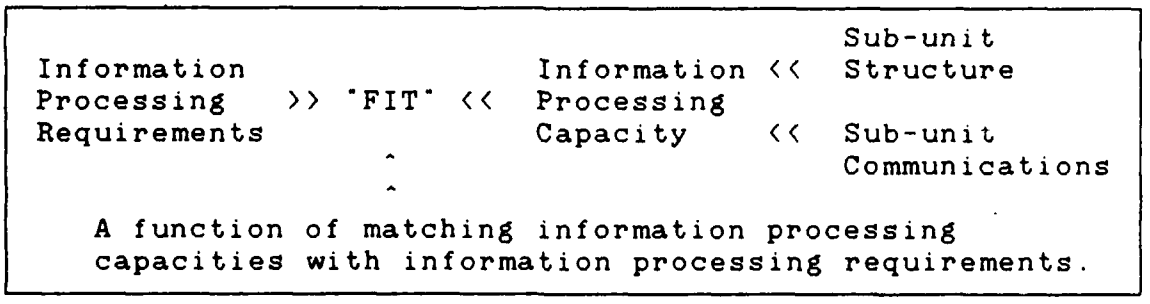

Fig. 4. Adaptation of Tushman and Nadler Information Processing Model (24)

To further understand this concept, each aspect of the model will be discussed in further detail. Every organization has an idea of how many requests and orders it will receive in the future, but the exact number is

uncertain. This **uncertainty** facing the organization is driven by several contextual factors. These factors are organizational technology, the perceived environmental uncertainty, and the inter-unit dependence (24:622).

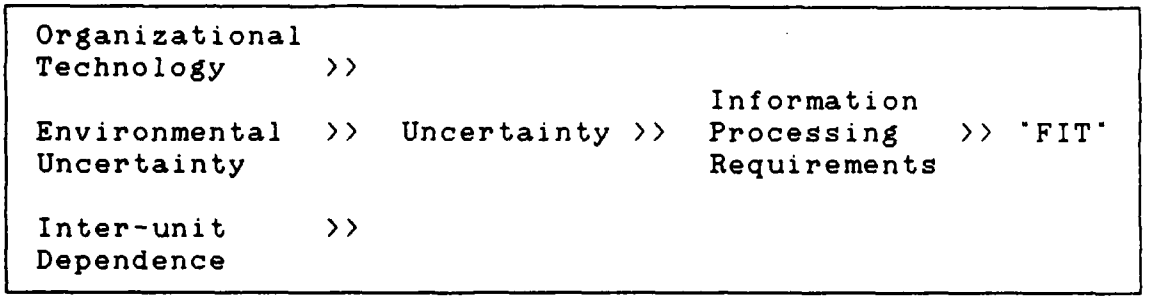

Fig. 5. Contextual Factors That Drive the Level of Uncertainty (23)

Organizational technology refers to those actions required to transform inputs to outputs (22:2), the task characteristics. Tushman and Nadler break the task characteristics down to task complexity and task interdependence (24:617).

The complexity of the task is directly related to the degree of uncertainty faced by the organization. 'Empirical studies have shown that complex, non-routine tasks require more information processing than simple, routine tasks ' (3:45). Thus, the more complex the task the greater the uncertainty. Task interdependence refers to the degree that the task is dependent upon other tasks within the unit. The assumption is that the greater the dependence, the greater the uncertainty and the information processing requirements

The second contextual factor driving uncertainty is the perceived environmental uncertainty. The environment is seen as a source of uncertainty because it is out of the control of the organization. While there are many factors contributing to environmental uncertainty, Duncan's categorization of organizational environments and the associated information processing requirements is the most useful. He found that the more dynamic the organization, the greater the uncertainty and the greater the information processing requirements (24:616).

The third contextual factor is inter-unit dependence. This factor deals with the degree to which a unit is dependent on another unit to perform its tasks. According to Tushman and Nadler, the task characteristics and the environment will drive the design of the sub-unit structure, while the inter-unit dependence will drive the need for coordination among the sub-units. Thompson talks of three types of inter-unit dependence; pooled, sequential, and reciprocal. Pooled inter-unit dependence refers to an organization consisting of a pool of independent sub-units feeding the whole, while sequential inter-dependence refers to a set of sub-units in series feeding each other. Finally the most complex interdependence is reciprocal, where the output of each unit becomes the input of the other (22:4). The more complex the inter-unit dependence, the greater the uncertainty.

In general, the complexity of the task, the dynamic nature of the environment, and the inter-unit dependence are each directly related to the uncertainty faced by the organization. The greater the uncertainty, the greater the information processing requirements.

In order to effectively meet the information processing requirements, the organization responds by modifying its information processing capacity. As noted earlier, the information processing capacity is driven by the sub-unit structure and the sub-units communication channels.

The sub-unit structure refers to whether the organization is mechanistic or organic. According to Burns and Stalker, the distinction between an organic and mechanistic organization can be determined from the degree of formalization, specialization, centralization, and impersonality of the organization. High formalization, centralization, and impersonality implies a mechanistic organization, while high specialization implies an organic organization (22:5). Generally, the more organic the organization the higher its information processing capacity, but the higher its coordination costs (24:618).

The second factor driving the the information processing capacity of the organization is the sub-units communication channels, or more specifically, its coordination and control mechanisms. The mechanisms control the linkages between the sub-units. Some of the mechanisms

identified by Galbraith in ascending order of cost, complexity, and information processing capacity are; rules and programs, hierarchy, joint planning, formal information systems (IS), and lateral relations (24:618). Each of these directly impacts the ability to coordinate between sub-units, but of special interest in this study is the IS.

The infusion of an information system in an organization, in terms of the organization as an information processor, will modify the organization's information processing capacity. However, the impact of the information system depends on how well the organization's information processing capacity matches its information processing requirements as demonstrated in the literature.

CBIS: Impact on Organizations

> The computer has fostered many speculations about its potential impact on human affairs in general and on organizations in particular. These range from very optimistic portraits of the future to warnings about unanticipated technological impacts. Since the future is likely to be neither as bad as the pessimists presume nor as good as the optimists would like it to be, we need to look at computers' current impact as a road to understanding the future. [2:3]

There have been many reasons given for the success and failures of CBIS in organizations. While each reason may be valid in its own organizational context, to date it has been difficult to compare these results to each other. This is primarily due to the way each researcher defines the linkages between the CBIS and the organization (12:63).

Furthermore, as Leifer points out, each researcher tends to define the term computer-based information system in his own way. The phrase, computer-based information system, is in fact a generic term referring to classes of systems (12:63). Thus the first step in an analysis of the impact of CBIS on an organization should be to categorize the type of information system involved. The next step would be to see if it matches the organizational structure.

Based on their architecture, CBIS can be broken into three categories. The first type is a **centralized system**. A centralized system is one that is based around a mainframe computer that is accessed through dumb terminals; one in which there is no independent computing power. The second type is known as a **distributed system**. In a distributed system, the main frame is accessed through a computer which has its own processing power, a smart terminal. Thus files can be uploaded, downloaded, processed and stored at either end of the system. Note, that the only difference between a distributed and centralized system is the processing and storing capability at the users end. The third type of system is known as a **decentralized system**. A decentralized system does not interact through a mainframe, but rather each computer is networked to each other directly (12:64). This type of interaction provides more reliability and quality to the information being processed as well as more flexibility to the overall system (12:64).

There is a fourth category known as **stand-alone systems**, but these systems, usually desktop PCs, impact the user more than the organization. Naturally through the individual the organization is impacted, but this research focuses primarily with those systems that can be used to transfer information and thus directly impact the organization. Specifically, this research effort dealt with a distributed CBIS system.

The distributed system according to Leifer is appropriate for a professional bureaucracy. The professional bureaucracy can be characterized as one with little formalization, bureaucratic standardization, decentralization and high skill specialization that acts in a stable yet complex environment. The HE Division fits this description.

Leifer goes on to describe several aspects about the professional bureaucracy that are relevant to this effort.

> At first glance, informational needs of people in this organizational design might appear to be high. Experience shows this is not the case. Whether it be a law firm, a consulting firm, or a university, there is relatively little task oriented information processing among colleagues, except perhaps when a particular skill is needed by another professional to solve the problem. Most coordination is accomplished by administrators, and most information needs are related to the accumulated organizational history in the form of historical or specialized task knowledge. Perhaps, most importantly, access to external sources of specialized information/databases, such as medical case studies, stock market activity, or legal briefs, is of greater value than internal informational databases. [12:68]

These observations by Leifer are critical to this study. In effect, the observations imply that the research should not find any significant increases in task oriented processing. Furthermore, the preferences of the members of the HE Division should be towards access of external database sources rather than internal database sources. Both these observations can be used as a post-facto analysis revalidating the researchers contention that for this particular study - the CBIS is effectively matched to the organizational structure.

Having established the type of information system and organizational structure involved in this effort, it is time to examine some of the potential impacts of information systems on organizational structure.

As noted earlier, the evidence on the impact of information systems on organizations is mixed. Daniel Robey, in his 1981 article "Computer Information Systems and Organizational Structure", argues that computer-based information systems do not impact the formal structure of the organization. In five of eight organizations he studied, there were no changes to the formal organizational structure. And where changes did occur, they reinforced the existing structure. Thus Robey contends that, "these cases seem to fuel arguments against technological determinism" (18:686). His overall finding was that "CBIS do not cause structural changes in organizations" (18:686).

In a later study, Robey extends his argument further. While acknowledging that there is some type of impact after implementation of CBIS, he argues that they are "accidental impacts" (19:76). He further points out that this finding is consistent with Markus' position about the implementation process. She contends that "technology alone is insufficient to explain the impacts; the design objective for a system and the existing organizational structures must also be understood" (19:75). In effect, Robey and Markus are saying that impacts on the organization can only be explained when we know how and why the system was developed. Robey calls this the systems' development history. He defines development history as including, "the intentions of managers, designers, users, and interested parties outside the organization" (19:73). While the author concedes that the impact can only be understood when the development history is understood, it nonetheless reemphasizes the point that information systems do impact the organization.

In another study by Body and Buchanan, several structural changes were identified. For instance, several paper-based clerical jobs were redefinitized, there was the addition of an Information Support Center, there were changes in the use of the hierarchy, and new interdependencies appeared among departments (9:146-150). In an attempt to explain these impacts, Boddy and Buchanan identify three factors: "the capabilities and limitations

of the technology chosen for the task, the objectives of management, and the physical organizational structures that already existed" (19:75). These factors are consistent with Robey and Markus' findings that the system's development history needs to be known, but instead they say that the objectives of management, and the physical organizational structures that already existed need to known. Furthermore, Boddy and Buchanan's claim that the "capabilities and limitations of the technology chosen for the task must be identified in order to explain the CBIS impact," is in line with the first step identified in this part of the chapter - the need to identify the type of CBIS used (19:75).

Now that it has been established that a CBIS does impact an organization, a description of the types of impacts is required. According to Bjorn-Andersen in his book, Managing Computer Impact: An International Study of Management and Organizations, CBIS impact two different levels of the organization; the individual and the organization. The integrating concept found most useful between these two levels was that of the task. One reason for using the task is explained by Bjorn-Andersen below.

> At the organizational level, the fundamental purpose of an organization has been referred to as its primary task, and leadership style, conflicts, distributions of responsibility, etc., have been studied in task-centered situations. At the individual (human-machine) level it is commonplace to refer to the task of the individual as a critical variable, and Eason has attempted a task-tool analysis of manager-computer interaction. [2:7]

Thus, the concept of task can be found at all levels of the organization. Given that tasks appear at all levels of the organization, one way to relate the organizational impacts to the individual impacts is through the concept of task specialization.

> The essence of this approach is that an organizational task, once it is broken into sub-tasks and allocated to departments and individuals within them, inevitably leads to interdependencies between the individuals engaged in sub-tasks. The extent and nature of these interdependencies is determined by characteristics of the environment, the nature of the task, and the way the sub-tasks are allocated. [2:7]

Thus it is clear that the task should be the integrating concept that serves as the link between the impact of the CBIS at the organizational level and the individual level. Andersen describes this CBIS impact in the following model.

Model of CBIS Impact on Organization

```
                              >>>  CHANNELS OF COMMUNICATION
COMPUTER SYSTEM IMPACTS  >>>>
                              >>>  TASK
                              >>>  FORMAL STRUCTURE
```

Fig. 6. Adaptation of Andersen's Sub-Model for CBIS Impacts at the Organizational Level (2)

Basically Andersen is describing the impact of CBIS in terms of impacts on organizational communication, task performance, and organizational hierarchy. This approach

appears to be the most common method of understanding the impact of CBIS on organizations. Another study which followed this approach was the Foster and Flynn study which served as the basis for this research effort.

Foster and Flynn Case Study

This case study is derived from the experiences of one particular organization, The General Motors' Environmental Activities staff. This study served as the basis for this research design (8:229).

The staff itself consisted of approximately 180 people including managers, professional and clerical workers. The study identified the impact of a distributed CBIS on the organization - 18 months after it was implemented (8:229).

The main role of the staff is to design and recommend policy to senior company officials. The staff also plays a monitoring role by insuring that the company is complying with all current government regulations, and at the same time monitoring all new legislation that may impact the company (8:230).

The CBIS consisted of personal computers linked through a network that allowed the workers to send mail and files through the system. Training was provided to all the workers. The goal of system implementation was to integrate the planning effort of the entire staff (8:230).

The study reported changes in organizational communication, changes in the use of the organizational

hierarchy, and changes in task performance. The changes in organizational communication consisted of an increase in the absolute number of communications, an increase in the degree of task focused messages, and an increase in the number of personal contacts between members (8:230).

There were two changes in the use of the organizational hierarchy. The first consisted of a move from position power to competency power; through the system the members were able to identify, and contact directly, those people who had the skills they required. The second finding consisted of what is now known as **electronic peeping**. Members can now communicate directly with the supervisor's boss electronically, thus violating the traditional chain of command. Furthermore, the supervisor's boss can dip down to the lowest level in the chain (8:232).

The findings in task performance consisted of an increase in the amount of time available for task performance, a shift from tasks being identified as my job to one of a team effort, and finally the tasks became more fluid and dynamic. The latter gave the manager the ability to redefine various jobs within the organization (8:233). These findings when taken together demonstrate that computers based information systems can have major impacts on organizations. Combined with the research findings mentioned earlier, it clear that CBIS impact organizations.

Whether the impact is accidental or a form of technical determinism is not the thrust of this research effort.

Chapter Summary

This chapter first reviewed the concept of organizations as informations processors. This concept demonstrates why the impact of a computer based information system on an organization is critical to understand. If organizations are information processors, then the technical infusion of an information system is clearly going to impact all levels of the organization. The second section was devoted to the types of impacts on an organization and their dependence on the type of information system and the type of organizational structure. To minimize the impact, one should attempt to match the information system type and the organizational structure. The third section detailed the Foster and Flynn study that served as the basis for the research design. A review of the significant findings were presented with special emphasis on task performance, organizational communication, and organizational hierarchy, which served as the three main areas of investigation in this research effort.

III. Methodology

Overview

This research effort identifies the perceived impacts of a distributed CBIS on a USAF research and development laboratory. The research took place two years after the CBIS was implemented. Specifically, the research examined whether a CBIS would impact organizational function and form within the Human Engineering Division located at Wright-Patterson Air Force Base, Ohio. In addition, it attempted to identify if any demographic groups within the HE Division were impacted by the information system more than others.

The investigation was performed in two parts. The first part consisted of a survey given to all eligible government and contractor employees within the organization (see sample and setting for exclusions). The intent of the survey was to identify whether members of the organization **perceived** that the CBIS had an impact on the organization, and if it had, what areas and which groups had been impacted the most.

Following a thorough analysis of the data, semi-structured interviews were conducted with the Branch Chiefs of the organization. The intent of the interviews was to determine if supervisors perceived the same CBIS impacts as did the organizational members, and to research whether

there could be any other explanations for the perceived impacts in organization function and form.

Methodology Justification

The method chosen to study the impacts of the CBIS on organizational function and form was a case study. There are two main reasons for the selection of the case study approach. The first is that 'there is a strong case-study tradition in the academic field of management information systems' (11:33). In order to understand the impact of the CBIS on an organization, the case-study approach is nearly inevitable. The second reason is that this research effort is based on a similar case-study performed by Foster and Flynn. Every attempt has been made to keep the only difference between the two case-studies as the type of organization. Foster and Flynn examined a product organization while this study deals with a research and development (organic) organization.

The method chosen to measure the perceived impacts within this case was the survey. While questioning each member of the HE Division in person would be the most versatile approach, due to time constraints, it would not have been practical to interview the nearly 200 people in the Division. Thus the survey was considered the most efficient method of collecting the necessary data. The survey instrument is attached in Appendix A.

However, because there are only seven Branch Chiefs within the HE Division, the interview method was selected as the appropriate follow on method. This method provides the depth and detail from the respondent that cannot be secured by survey. According to Emory, "It (face-to-face interview) far exceeds the information secured from telephone and mail surveys. The interviewer can also do more things to improve the quality of information received" (7:160). In addition, the personal interview allowed the researcher the ability to probe with additional questions for clarifications.

A problem with personal interviews are that the personal responses are subject to the interviewers interpretation, thus leading to a chance of bias (7:161). Since the researcher is a former member of the organization, a semi-structured interview was used to avoid possible bias. The semi-structured interview (see Appendix B) guided the interview in a direction that addressed the critical issues identified in the survey analysis. It, along with the awareness of a potential problem, enabled the researcher to minimize bias effects.

Sample and Setting

Every eligible government and contractor member within the organization was surveyed. Those ineligible were the supervisors, the executive staff, and those personnel involved in organizing and coordinating the survey. The supervisors and the executive staff were not surveyed

because they had direct access to the Division Chief, thus they would have not been able to answer those questions dealing with the impacts on organizational hierarchy. Instead, it was decided that these members should be interviewed as a follow on to the survey. Those that had helped organize and coordinate the survey were not surveyed because they had direct input in organizing the survey; thus, there was a potential for bias.

In addition, those members not present at least one year before the implementation of the CBIS were identified through one of the survey questions and eliminated from the analysis. This was done because it would have been impossible for these members to compare the way the communication system used to be to the way it currently exists. As a result, 153 surveys were distributed (78 to government personnel and 75 to contractor personnel). Ninety-nine surveys were returned for a response rate of 64.8 percent. For a complete government versus contractor breakout, see Appendix C.

The HE Division, the organization selected for the case study, is a research and development organization in the true sense of the words. The majority of its work falls under the heading of Basic Research and Exploratory Development. The two smaller project offices are involved in Advanced Development, but this is a minor portion of the

HE Division's efforts. In addition over 65% of the government researchers have advanced degrees.

Most of the government and contractor personnel work in one of two 4 story buildings. This is significant because of the distribution of the Branches throughout the two buildings. Two of the technical Branches (HEG and HEF) have personnel located in both buildings on different floors, while a third technical Branch has personnel located on different floors, but the same building (HED). The fourth technical Branch is located on the same floor but divided into four isolated work areas (HEA). The two project offices and the support Branch are on the same floor.

Measures

The focus of this research was to identify the perceived impacts, if any, of a CBIS system on organizational form and function. Thus, the results and analysis from this study are based on perceptual measures as reported by the organizational members. The survey questions were derived from potential CBIS impacts identified in the literature. Specifically, the attitudinal scales used in this study dealt with the CBIS impacts on organizational communication, performance of tasks, and organizational hierarchy, as discussed by Foster and Flynn. The survey questions related to each of these three topics are displayed in Table I.

Table I

Attitudinal Scales and Associated Questions

I. Impacts on Task:

1. Task Efficiency - refers to one's ability to perform tasks in a timely, productive manner. (10,22,25)

2. Task Coordination - refers to the task review process one is required to go through prior to task completion. (14,19,36)

3. Task Workload - refers to one's ability to handle more work. (26,34,35)

II. Impacts on Hierarchy:

4. Chain of Command - refers to the adherence of the chain- of-command in the transmission of task related communications. (11,23,28)

5. Informal - refers to the development of personal contacts and networks that transcend organizational boundaries. (17,21,24,37)

III. Impacts on Communication:

6. Departmental - refers to the change in the number of and improvement of communications **within** the sub-unit due to the information system. (12,38,42)

7. Interdepartmental - refers to the change in the number of and improvement of communications **between** sub-units due to the information system. (18,29,41)

8. Organizational - refers to the change in the number of and improvement of communications **across** every sub-unit at once, organizational-wide. (13,39,43)

9. Paperwork Reduction - refers to the amount of paper used to accomplish your tasks. (9,27,15)

10. Message Content - refers to the proportion of information system messages that are task related. (16,20,40)

Survey Instrument

A 5-point Likert Scale was used to determine the degree to which respondents strongly disagree or strongly agree with the various CBIS impacts asked in each question. An advantage of the Likert scale according to Emory is that, 'one can study how responses differ between people, and how responses differ between stimuli' (7:258). A disadvantage of the Likert scale is that you cannot tell how much more or less favorable they are to a particular CBIS effect.

The survey instrument was divided into four parts as discussed below. The first part had eight questions. It was used to collect demographic information about the respondents in order to answer the fifth research question. The fifth research question deals with the issue of whether certain groups within the organization have been impacted by the CBIS significantly more than other groups (see page 12). Thus, the responses were categorized by the demographic groups as shown in Table II in order to answer research question five.

Table II

Demographic Groups

1.	Primary Job Description
2.	Sub-Unit Assigned
3.	Age
4.	Amount of CBIS usage
5.	Amount of Computer Usage
6.	Degree of Task Interdependence
7.	Location of Coworkers.

A final question was asked to determine if the respondent was present at the organization prior to the implementation of the CBIS. This was critical because only those personnel present at HE Division prior to the CBIS implementation could perceive a CBIS impact.

The second part consisted of statements dealing directly with the three potential impacts of the CBIS identified in Table I. These statements address research questions two through four, determining the impact on organizational communication, tasks, and hierarchy. The respondents were asked whether they agree or disagree with each statement using a a 5-point Likert-type scale as the method of measurement. The scale was arranged in ascending order, where a scale value of 1 is equal to a strongly disagree attitude and a scale value of 5 is equal to a strongly agree attitude. Note that a 3 was considered as neutral. Together these statements answered research question one, whether there is any CBIS impact on the organization.

The third part of the survey instrument was not intended for use in this research effort. It was added for the benefit of the organization to ask those questions relating to hardware and software issues about the system itself. Relevant data from this section was used in the analysis.

This final part was used to give the respondents the opportunity to identify any impacts which may not have been addressed in the survey. It also allowed the respondent the opportunity to more specifically address the impact of the CBIS on the organization. In addition, there were other open-ended questions which asked for suggestions that would make the system more valuable to them at work. These latter questions were for the benefit of the organization which is seeking to improve the utility of the system. The validity of the survey was addressed by pilot testing. 'Validity refers to the extent to which a test measures what we actually wish to measure' (7:94). An instrument is valid when it has the ability to carry out what it is intended to accomplish. For this research effort, the pilot test was used to refine the survey. The goal of the pilot test was to insure that no questions were misleading or ambiguous, and met the objective of measuring what was intended to be measured. The pilot test was conducted on four ex-members of HE Division who had recently transferred (within 6 months) to other organizations. In addition, the questions were reviewed by two experts in survey construction, and by several members of HE Division for question content. As a result of the pilot test, several questions were modified grammatically in order to clarify their intent. In addition, one question was added to determine the tenure of the respondent.

Statistical Analysis

The data analysis was done using the Statistical Package for the Social Sciences - X (SPSSX) located on AFIT's Academic Support Computer (ASC). The statistical techniques performed were descriptive statistics, correlation analysis, reliability analysis, and analysis of variance. It is important to note that the data was assumed to be interval data with equal intervals between choices. A description of each technique used follows.

Descriptive statistics include frequency data, means, and standard deviations for each question in the survey. Furthermore, descriptive statistics were also taken for each attitudinal scale in the survey (variable scores were the sums of several questions). **The mean and standard deviation were used to measure with preciseness the degree to which the members of the organization disagreed or agreed that the CBIS impacted one of the 10 attitudinal scales.** The frequency data served as an excellent tool to screen the responses for answers out of the Likert-scale range, and to make inferences on the respondents perceptions of the degree of impact on each attitudinal scale (percentage agree or disagree).

A Pearson product-moment correlation analysis provided correlation coefficients, the significance of the probability of correlation, and the number of observations used to calculate the coefficient. Coefficient values range

from -1.0 to 1.0, where the latter implies perfectly positive linear relationship and a -1.0 implies a perfectly negative linear relationship. It is important to note that a high correlation does not imply a causal relationship. The only conclusion that can be drawn from a high correlation is that a linear trend may exist.

The resulting correlation matrix was used to check whether the attitudinal scales were correlated and in which direction (positive or negative) did the linear relationship go. Prior to performing the study it was envisioned that some of the attitudinal scales may be correlated with each other since, in fact, the scales sum to even higher level scales (task, communication, hierarchy). The main concern was to be sure that the direction of the linear relationship was consistent with the literature.

The reliability of the survey was addressed using Cronbach's Alpha. Reliability is a measure of consistency. "It has to do with the accuracy and precision of a measurement procedure. It is a necessary but not sufficient condition for validity" (7:98).

Reliability is of special concern for this study because the score for each attitudinal scale actually consists of the sum of three survey questions. As such, it is critical that each question is consistently measuring precisely that which it was intended to measure. According to Steel, there is no set Alpha value which is acceptable or

unacceptable - it depends on the situation. However, as a rule of thumb, an Alpha level of 0.6 to 0.7 is borderline at best, while an Alpha above 0.7 and up is acceptable (22). The analysis of variance was done to determine whether there were significantly different responses between the demographic groups identified in Part I of the survey (job, branch, age, falcon usage, computer usage, task interdependence, and location). The analysis was done using the Oneway command on SPSSX.

The first multiple comparison test run was the Studentized-Newman-Kuels (SNK) procedure at an alpha level of 0.05. Than in order to get significant differences at an alpha level of 0.1, it was necessary to choose a different test as SPSSX limits SNK to an alpha of 0.05. The second test run was the Duncan test at an alpha level of 0.1 It was chosen because it is popular among researchers.

> Because the protection level decreases with increasing r, Duncan's Multiple Range Test is very powerful. That is, there is a high probability of declaring a difference when there is actually a difference between the population means. This has been one of the reasons Duncan's procedure has been extremely popular among researchers. [16:452]

Interview Process

Interviews were performed for two reasons. The first reason was to determine if the supervisors and executive staff perceived the same impacts from the CBIS as did the employees. The second reason was to follow up on the survey

results to see if the supervisors and executive staff had alternate explanations for the impact of the CBIS.

A total of seven semi-structured interviews were conducted. All the interviews were done in person. Appendix B contains the interview questions, and the results of the interviews were incorporated into the results in Chapter V. The thrust of the interview was to determine if the supervisor's perceived an impact on organizational communication, organizational hierarchy, and task performance.

Chapter Summary

This chapter detailed the methodology used in this research effort. It presents the rationale for using a case study approach with a survey as the primary measuring tool and interviews as the follow-up technique. A description of the sample, setting, measures, and survey instrument followed. The following chapter presents the results of the survey analysis. Chapter V is a discussion of the results.

IV. Results

Overview

This chapter presents an analysis of the survey instrument, the attitudinal scales, and the survey responses. Overall 153 surveys were distributed throughout the HE Division and 99 were completed and returned. The implications of these responses, in terms of each research question, are discussed in detail in Chapter V.

The first part of this chapter contains the results of the survey's internal reliability analysis. The internal reliability was assessed using Cronbach's Alpha. The second part of the chapter addresses the results of the correlation analysis. This was done to identify associations between the 10 attitudinal scales. The third part of the chapter presents the tabular results of the survey questions. It begins by presenting the tabular frequency distributions for each demographic group. This is followed by the overall Likert scale scores for each attitudinal scale. It ends by identifying the significantly different demographic groups within each attitudinal scale.

Finally, the goal of this research was to determine the perceived impact of the computer based information system on the organization. As such, it was necessary to distinguish between those personnel that were assigned to the HE

Division prior to implementation of the information system and those that were not. Question number eight was used to identify those personnel that had **not** been assigned to HE Division for at least one year prior to system implementation. As a result of this question, 22 responses were eliminated from the survey analysis.

Internal Reliability Analysis

Internal reliability analysis is done to check for consistency among the respondent's responses. It is the resulting reliability measure that gives the survey internal validity. For this survey, the internal reliability analysis was done using Cronbach's Alpha.

The reliability analysis using Cronbach's Alpha was done with SPSS-X. Each of the 10 attitudinal scales, made up of three items apiece, were analyzed for internal reliability. As noted earlier in Chapter 3, a value greater than 0.6 is considered marginal, greater than 0.7 fair, greater than 0.8 good and greater than 0.9 excellent. The results of the reliability analysis for each of the attitudinal scales are shown in Table III.

The table shows that all 10 scales were answered consistently. The only questionable scales was the **organizational** scale. Its alpha was originally .48, which was considered low according to the previous mentioned standard. In order to raise the internal reliability of this scale, one of the items was deleted (question 43).

With this change, Cronbach's alpha for the organizational scale is now acceptable (alpha = .6750). Based on the overall results, the survey appears to have moderate to high internal validity.

Table III

Internal Reliability of Survey Instrument

Attitudinal Measure	# of Items	Cronbach's Alpha
Task Efficiency	3	0.8802
Task Coordination	3	0.6319
Task Workload	3	0.7296
Chain of Command	3	0.6773
Informal	4	0.8052
Departmental	3	0.7071
Interdepartmental	3	0.6511
Organizational	2	0.6750
Paper Work	3	0.8466
Message Content	3	0.8681

Correlation Analysis

The intent of this part is to determine if some of the attitudinal scales are associated with each other. In fact, because the 10 attitudinal scales are really a subset of three grand scales (organizational task, organizational hierarchy, and organizational communication), high correlations were expected. Perhaps a factor analysis should have been done to reduce the number of scales, but it was not within the scope of this research effort. The goal in this study was to measure the impact on each of the three grand scales. In order to do this, each attitudinal scale was developed to measure an aspect of the grand scale.

Though each attitudinal scale was not mutually exclusive from the others, it did measure an aspect of the grand scale different from the others. Table IV provides the results of the correlation analysis.

An examination of Table IV reveals that the highest correlations are in fact among the attitudinal scales located within the three grand scales. The table shows that the three task scales (task efficiency, task coordination, and task workload) are each correlated at a level of 0.518 or greater. While the communication scales (departmental, interdepartmental, and organizational) are also correlated at a level of at least 0.655. And lastly, the hierarchy measures (chain of command and informal) are correlated at a level of 0.479. These high values are not a problem, but merely suggest that the attitudinal scales within each grand scale are in some way associated.

Demographic Data

Demographic data was collected on all the respondents using the first seven survey questions. It included data on the respondent's primary job, organizational assignment (sub-unit/branch), age, amount of information system usage (by the number of log on's), amount of computer usage (by hours), task interdependence, and location of coworkers. The results by demographic group are presented in Tables V through Table XI. Note that in some instances the values do not total 100 percent due to rounding errors or missing values.

Table IV.

Correlation Matrix

Attitudinal Scales	1	2	3	4	5	6	7	8	9	10
1. Task Efficiency	1.0									
2. Task Coordination	.729	1.0								
3. Task Workload	.632	.519	1.0							
4. Chain of Command	.357	.191	.414	1.0						
5. Informal	.480	.275	.440	.480	1.0					
6. Departmental	.591	.482	.517	.214	.534	1.0				
7. Interdepartmental	.414	.323	.539	.128	.318	.630	1.0			
8. Organizational	.326	.266	.501	.359	.428	.716	.656	1.0		
9. Paper Reduction	.593	.497	.702	.395	.418	.444	.382	.286	1.0	
10. Message Content	.533	.497	.370	.173	.281	.279	.213	.154	.396	1.0

Table V

Distribution of Respondents by Primary Job

Primary Job	Frequency	Percent
Administrative/Clerical	6	9.1
Technician	3	4.5
Engineer	20	30.3
Researcher/Scientist	25	37.9
Computer Programmer	9	13.6
Other	3	4.5
Total	66	99.9

Table VI

Distribution of Respondents by Sub-Unit

Sub-Unit (Branch)	Frequency	Percent
HEA	6	9.0
HED	8	11.9
HEG	5	7.5
HEF	11	16.4
HEX	2	3.0
On-site Contractor	31	46.3
Project Offices	4	6.0
Total	67	100.1

Table VII

Distribution of Respondents by Age

Age	Frequency	Percent
20-30	15	22.4
31-40	25	37.3
41-50	17	25.4
51-60	10	14.9
61 and over	0	0.0
Total	67	100.0

Table VIII

Distribution of Respondents by CBIS Usage

Log Ons Per Day	Frequency	Percent
Less than 1	7	10.4
1 or 2	19	28.4
3 or 4	22	32.8
At least 5	5	7.5
Stay on all day	14	20.9
Not at all	0	0.0
Total	67	100.0

Table IX

Distribution of Respondents by Computer Usage

Hours Per Day	Frequency	Percent
Less than 1/2	11	16.4
1/2 to 1	6	9.0
1 to 2	18	26.9
More than 2	32	47.8
None at all	0	0.0
Total	67	100.1

Table X

Distribution of Respondents by Task Interdependence

Required Coordinations	Frequency	Percent
Supervisor only	12	17.9
Supervisor and Less Than or equal to 2 Peers	24	35.8
Supervisor and Greater Than 2 Peers	21	31.3
None	10	14.9
Total	67	99.9

Table XI

Distribution of Respondents by Coworker Location

Distance from Coworkers	Frequency	Percent
Within 25 feet	16	23.9
Beyond 25 feet, but Less Than 50 feet	8	11.9
Beyond 50 feet but on the Same Floor	11	16.4
On Another Floor	32	47.8
Total	67	100.0

Attitudinal Scales

Table XII summarizes the results of the perceived impacts to the 10 attitudinal scales. The 10 attitudinal scales were computed from the 31 questions in Part II of the survey. Each scale was computed from a series of 3 questions with the exception of the attitudinal scale called **informal**; it was the result of four questions.

Table I (see page 36) provides a definition of each scale. Note that the mean score of the measure reflects the overall Likert scale score. In the 5-point Likert scale used in this survey, a value of one reflected a strongly disagree attitude, while a value of 5 reflected a strongly agree attitude. The value of 3 was designated as a neither agree nor disagree attitude. The resulting scores can then be interpreted as reflecting a perceived impact by the

members. Thus the mean score of the attitudinal scales play a vital role in answering the first four research questions. Also included in Table XII is the percentage of members that agreed or disagreed with the attitudinal scale. Note that the percentages do not sum to 100 percent. The difference reflects the members who neither agreed nor disagreed with the perceived impact.

Another aspect of the research (research question five) was to determine if any categories within a demographic group were significantly different from another category. This analysis was done by a one-way anova analysis using SPSS-X. Note that each attitudinal scale was analyzed by each demographic group. Significant differences were determined for the p=.05 and p=.1 level.

TABLE XII

Summary of Scores for Attitudinal Scales

Attitudinal Scale	Mean Score	Standard Deviation	Percent Agree	Percent Disagree
Task Efficiency	3.527	0.120	73.1	22.4
Task Coordination	3.567	0.088	73.1	13.4
Task Workload	2.657	0.097	23.9	55.2
Chain of Command	2.805	0.100	27.7	53.8
Informal	2.598	0.098	60.6	33.3
Departmental	3.846	0.085	86.6	9.0
Interdepartmental	3.607	0.075	74.6	11.9
Organizational	4.104	0.082	85.1	3.0
Paperwork Reduction	2.886	0.118	32.8	49.3
Message Content	3.602	0.118	71.6	22.4

For simplification purposes, the computer analysis variable names are used in the following table in place of

the full demographic group names. These shorter terms are shown in Table XIII. The overall results showing which attitudinal scales contained significant differences by demographic group are shown in Table XIV. Note that the interdepartmental scale was the only scale not containing a significant difference by demographic group.

Table XIII

Computer Name for Each Demographic Group

Demographic Group	Variable Name
Primary Job	JOB
Organizational Assignment	BRNCH
Age	AGE
CBIS Usage	FLCUSE
Computer Usage	COMUSE
Task Interdependence	INTER
Location of Coworkers	LOCATE

Table XIV

Attitudinal Scales Showing Significant Differences

Attitudinal Scales	Significant Demographic Groups
Task Efficiency	BRNCH, AGE, FLCUSE, INTER, LOCATE
Task Coordination	AGE, FLCUSE, INTER, LOCATE
Task Workload	JOB, BRNCH, COMUSE, LOCATE
Chain of Command	AGE
Informal	AGE
Departmental	BRNCH, AGE, INTER
Interdepartmental	NO two significantly different
Organizational	AGE
Paper Work	INTER
Message Content	BRNCH, AGE, INTER, LOCATE

In order to get a more in-depth analysis for research question five, the significantly different categories within each demographic group will be presented. This results in 24 tables showing the significantly different categories within each demographic group per the affected attitudinal scale. The tables used for this process consist of the group categorization, their resulting mean scores and their standard deviations. The significantly different categories will be noted by asterisk below each table. Unless otherwise noted below the table, all significant differences are at the p=.1 level.

By Primary Job. The oneway analysis by primary job revealed significantly different categories only within the **task workload** scale. In this case, the significantly different responses came from the researchers and the computer programmers. **Note that throughout the demographic group analysis, some of the group sizes are too small to appear statistically different.**

Table XV

Impact on Task Workload by Primary Job (p=.1)

Primary Job		Frequency	Mean Score	Std Dev
1.	Administrative	6	2.6111	.7123
2.	Technician	3	2.2222	1.0715
3.	Engineers	20	2.6667	.7873
4.	Researchers	25	2.8627	.8284
5.	Computer Programmers	9	2.1481	.7286
6.	Other	4	3.1111	.3849

* Group 4 and Group 5

By Sub-Unit. The second demographic group was sub-unit or branch (the terms sub-unit and branch are to be considered synonymous throughout this effort). Significantly different categories were found in the **task efficiency, task workload, departmental, and message content scales**. For the most part, the differences arose from the HED sub-unit and the contractor group.

Table XVI

Impact on Task Efficiency by Sub-Units (p=.1)

Sub-Units	Frequency	Mean Score	Std Dev
1. HEA	6	3.1111	1.0037
2. HED	8	2.7917	1.0681
3. HEG	5	4.1333	.6055
4. HEF	11	3.7273	.8003
5. HEX	2	4.0000	.4714
6. On-site Contractor	31	3.5054	1.0179
7. Project Offices	4	4.2500	.5963

* Group 2 and Groups 3, 4, 6

Table XVII

Impact on Task Workload by Sub-Units (p=.1)

Sub-Units	Frequency	Mean Score	Std Dev
1. HEA	6	2.6111	.5741
2. HED	8	2.4583	.9910
3. HEG	5	3.2000	.6912
4. HEF	11	2.9394	.9045
5. HEX	2	3.3333	.9428
6. On-site Contractor	31	2.4624	.7184
7. Project Offices	4	2.8333	.8389

* Group 3 and Group 6

Table XVIII

Impact on Departmental by Sub-Units (p=.1)

Sub-Units	Frequency	Mean Score	Std Dev
1. HEA	6	3.7222	.6469
2. HED	8	3.3750	.6284
3. HEG	5	4.1333	.4472
4. HEF	11	4.0606	.6293
5. HEX	2	4.0000	.4714
6. On-site Contractor	31	3.7957	.7337
7. Project Offices	4	4.3333	.8165

* Group 2 and Groups 3, 4

Table XIX

Impact on Message Content by Sub-Units (p=.1)

Sub-Units	Frequency	Mean Score	Std Dev
1. HEA	6	3.2222	1.1287
2. HED	8	3.1250	1.0380
3. HEG	5	3.9333	.9832
4. HEF	11	3.2121	1.0140
5. HEX	2	2.5000	1.1785
6. On-site Contractor	31	3.8495	.8020
7. Project Offices	4	4.4167	.4194

* Group 6 and Groups 2, 4

By Age. The third demographic group was age. The most significant difference in this group appears in the 51-60 age category. Apparently the older members of the organization are not in agreement with the rest of the organization regarding the impact of the information system. This age category was significantly different in seven of the 10 attitudinal scales.

Table XX

Impact on Task Efficiency by Age (p=.1)

Ages		Frequency	Mean Score	Std Dev
1.	20-30	15	3.7778	1.0053
2.	31-40	25	3.3467	.9500
3.	41-50	17	3.8824	.8160
4.	51-60	10	3.0000	1.0657
5.	61 and over	0	0	0

* Group 4 and Groups 1, 3
** Group 2 and Group 3

Table XXI

Impact on Task Coordination by Age (p=.1)

Ages		Frequency	Mean Score	Std Dev
1.	20-30	15	3.7333	.6808
2.	31-40	25	3.4400	.7621
3.	41-50	17	3.8431	.5788
4.	51-60	10	3.1667	.7071
5.	61 and over	0	0	0

* Group 4 and Groups 1, 3
** Group 2 and Group 3

Table XXII

Impact on Chain of Command by Age (p=.1)

Ages		Frequency	Mean Score	Std Dev
1.	20-30	13	2.6154	.5908
2.	31-40	25	2.9600	.7777
3.	41-50	17	2.9608	1.0533
4.	51-60	10	2.4000	.4919
5.	61 and over	0	0	0

* Group 4 and Group 2

Table XXIII

Impact on Informal by Age (p=.1)

Ages		Frequency	Mean Score	Std Dev
1.	20-30	14	2.5179	.6002
2.	31-40	25	2.7500	.7360
3.	41-50	17	2.7206	1.0602
4.	51-60	10	2.1250	.5303
5.	61 and over	0	0	0

* Group 4 and Groups 2, 3

Table XXIV

Impact on Departmental by Age (p=.1)

Ages		Frequency	Mean Score	Std Dev
1.	20-30	15	3.9111	.8861
2.	31-40	25	3.9867	.5225
3.	41-50	17	3.8824	.6555
4.	51-60	10	3.3333	.6849
5.	61 and over	0	0.	0

* Group 4 and Groups 1, 2, 3
** Group 4 and Group 3 Different at **p=.05**

Table XXV

Impact on Organizational by Age (p=.1)

Ages		Frequency	Mean Score	Std Dev
1.	20-30	15	4.0667	.7761
2.	31-40	25	4.2200	.5017
3.	41-50	17	4.0882	.7339
4.	51-60	10	3.9000	.8097
5.	61 and over	0	0	0

* Group 4 and Group 2

Table XXVI

Impact on Message Content by Age (p=.1)

Ages		Frequency	Mean Score	Std Dev
1.	20-30	15	3.7111	.7854
2.	31-40	25	3.6800	.8135
3.	41-50	17	3.8235	1.0282
4.	51-60	10	2.8867	1.2090
5.	61 and over	0	0	0

* Group 4 and Groups 1, 2, 3
** Group 4 and Group 2 Different at p=.05

By Information System Usage. The fourth demographic group was CBIS usage. This was an attempt to identify if members that use the information system more than others perceive a greater impact than those who do not. The results show a significant difference between those who use the system more than once a day and those who do not.

Table XXVII

Impact on Task Efficiency by CBIS Usage (p=.05)

Log Ons per Day		Frequency	Mean Score	Std Dev
1.	Less Than 1	7	2.4762	.8576
2.	1 or 2	19	3.3684	1.0476
3.	3 or 4	22	3.6818	.9676
4.	At Least 5	5	4.0000	.5774
5.	Stay on All Day	14	3.8571	.7246
6.	Not at All	0	0	0

* Group 1 and Groups 2, 3, 4, 5

Table XXVIII

Impact on Task Coordination by CBIS Usage (p=.1)

Log On's per Day	Frequency	Mean Score	Std Dev
1. Less than 1	7	3.2381	.4179
2. 1 or 2	19	3.2632	.8209
3. 3 or 4	22	3.6970	.6659
4. At Least 5	5	4.0667	.7226
5. Stay on All Day	14	3.7619	.6052
6. Not at All	0	0	0

* Group 2 and Groups 3, 4, 5
** Group 4 and Group 1
*** Group 2 and Group 3 Different at p=.05

By Computer Usage. The fifth demographic group was computer usage. This was an attempt to identify if those personnel who use computers more than others would perceive the impact of the CBIS differently. The only statistically different categories were in the task workload scale. Members that use computers for more than two hours a day were less inclined to disagree that the CBIS impacted task workload.

Table XXIX

Impact on Task Workload by Computer Usage (p=.1)

Hours per Day	Frequency	Mean Score	Std Dev
1. Less than 1/2	11	2.6970	.5045
2. 1/2 to 1	6	2.8889	.7201
3. 1 to 2	18	2.3148	.8042
4. More than 2	32	2.7917	.8582
5. None at all	0	0	0

* Group 3 and Groups 4

By Task Interdependence. The sixth demographic group was interdependence. This variable measured the number of

coordinations required to complete one's primary task. It was expected that the more coordinations one was required to complete, the higher the perceived CBIS impact on the attitudinal scales. This variable had significantly different categories appear in half of the attitudinal scales.

Table XXX

Impact on Task Efficiency by Interdependence (p=.1)

Required Coordinations	Frequency	Mean Score	Std Dev
1. Supervisor only	12	3.6111	.8971
2. Supervisor plus one or two peers	24	3.3889	.8494
3. Supervisor plus three or more peers	21	3.8254	1.0090
4. None	5	3.1333	1.2293

* Group 3 and Group 4

Table XXXI

Impact on Task Coordination by Interdependence (p=.1)

Required Coordinations	Frequency	Mean Score	Std Dev
1. Supervisor only	12	2.8889	.7566
2. Supervisor plus one or two peers	24	2.6528	.6176
3. Supervisor plus three or more peers	21	2.6825	.8594
4. None	5	2.3333	1.0773

* Group 3 and Groups 2, 4
** Group 3 and Group 2 Different at **p=.05**

Table XXXII

Impact on Departmental by Interdependence (p=.1)

Required Coordinations	Frequency	Mean Score	Std Dev
1. Supervisor only	12	3.4720	.6376
2. Supervisor plus one or two peers	24	3.5972	.5559
3. Supervisor plus three or more peers	21	3.7460	.5960
4. None	5	3.5000	.8051

* Group 4 and Groups 2, 3

Table XXXIII

Impact on Paperwork by Interdependence (p=.1)

Required Coordinations	Frequency	Mean Score	Std Dev
1. Supervisor only	12	2.7500	.6376
2. Supervisor plus one or two peers	24	2.9306	.7613
3. Supervisor plus three or more peers	21	3.1905	1.1719
4. None	5	2.3000	1.1050

* Group 3 and Groups 2, 4

Table XXXIV

Impact on Message Content by Interdependence (p=.1)

Required Coordinations	Frequency	Mean Score	Std Dev
1. Supervisor only	12	2.8889	.7566
2. Supervisor plus one or two peers	24	2.6528	.6176
3. Supervisor plus three or more peers	21	2.6825	.8594
4. None	5	2.3333	1.0773

* Group 3 and Group 1

By Coworker Location. The seventh demographic group dealt with the location or proximity of coworkers. Data was gathered on the location of coworkers that the respondents worked with most. It was expected that the further the key coworkers, the greater the perceived impact from the system. The analysis shows significantly different categories in four of the 10 attitudinal scales.

Table XXXV

Impact on Task Efficiency by Location (p=.1)

Distance from Coworkers	Frequency	Mean Score	Std Dev
1. Within 25 feet	16	2.9583	1.0391
2. Beyond 25 feet and Less Than 50 feet	8	3.3333	1.1952
3. Beyond 50 feet but on same floor	11	3.9091	.5184
4. On another floor	32	3.7292	.9175

* Group 1 and Groups 3, 4
** Group 1 and Group 3 Different at p=.05

Table XXXVI

Impact on Task Coordination by Location (p=.1)

Distance from Coworkers	Frequency	Mean Score	Std Dev
1. Within 25 feet	16	3.125	.6979
2. Beyond 25 feet and Less Than 50 feet	8	3.125	.6652
3. Beyond 50 feet but on same floor	11	3.7273	.4671
4. On another floor	32	3.8438	.6719

* Group 3 and Groups 1, 2
** Group 4 and Groups 1, 2 Different at **p=.05**

Table XXXVII

Impact on Task Workload by Location (p=.1)

Distance from Coworkers	Frequency	Mean Score	Std Dev
1. Within 25 feet	16	2.2083	.7782
2. Beyond 25 feet and Less Than 50 feet	8	2.8750	.9345
3. Beyond 50 feet but on same floor	11	3.0000	.7303
4. On another floor	32	2.7083	.7561

* Group 1 and Groups 2, 3, 4
** Group 1 and Group 4 Different at **p=.05**

Table XXXVIII

Impact on Message Content by Location (p=.05)

Distance from Coworkers	Frequency	Mean Score	Std Dev
1. Within 25 feet	16	2.8125	1.0181
2. Beyond 25 feet and Less Than 50 feet	8	3.4167	.9041
3. Beyond 50 feet but on same floor	11	3.9394	.9640
4. On another floor	32	3.9271	.7121

* Group 1 and Groups 3
** Group 1 and Group 3 Different at p=.05

Chapter Summary

This chapter provided a summary of the survey instrument responses. The first part of the chapter begins with evidence supporting the internal reliability of the survey. After deleting one item from the survey, the internal reliability appears to be moderate to high. The second part of the chapter presents the results of the correlation analysis performed among the 10 attitudinal scales. The third part of the chapter presents the tabular frequency distributions of the demographic data. Next, the overall scores for the attitudinal scales are presented. Finally, the results identify the significantly different demographic groups within each attitudinal scale. The survey data, combined with the interview data, sets the foundation for the discussion of the research questions in Chapter V.

V. Analysis and Discussion

Overview

This chapter discusses the implications of the results presented in Chapter IV. Both the survey and interview data are used to answer the research questions that guided this effort. Each research question will be presented and answered sequentially in in this chapter.

Research Question 1

> Does an apparently well **fit** CBIS impact an organic type structure like that of a research and development organization?

Overall Impact. In this case, the results show that the computer based information system has clearly impacted the organization. As discussed in Chapter I, the information system in this organization appears to meet the criteria set forth by Markus and Robey to be considered well fit to the organizational structure (organizational validity).

The survey results displayed in Table XII (see page 52) clearly show that the newly implemented Information System at the HE Division is perceived by the respondents to have impacted the organization. According to the mean scores, the respondents perceived that the information system has impacted six of the 10 attitudinal scales. Furthermore, in six of the 10 attitudinal scales, over 70 percent of

respondents agreed that the information system has impacted the organization. Thus, it appears that most organizational members have perceived a CBIS impact on the organization. The degree to which each attitudinal scale has been impacted is addressed in research questions two through four.

The results from this study are not surprising considering the organizational environment. As discussed in Chapter II, the organization is not located in a central area, but in several different buildings. As such, past research by Allen suggests that an information system that could tie together the various sub-units would have a major impact on communication within the organization, and it did. In addition, research presented earlier by Bjorn-Andersen suggests that there should also be an impact on organizational tasks, and there was. However, the one area where the literature conflicted was on the impact to the organizational hierarchy. As mentioned earlier, most of the previous literature was on functional, mechanistic type organizations. Whether the CBIS impacts the hierarchy of on an organic type structure was not clear going into this effort. On this point, the results of the study are mixed.

Research Question 2

> What impact, if any, does a CBIS have on organizational communication in terms of direction, inter and intra sub-unit communications, and task-related content?

Communication Impact. The results, shown in Table XII, clearly indicate that the most significant organizational impact perceived was on organizational communication. The three attitudinal scales for communication received the three highest mean Likert scale scores of all 10 attitudinal scales. Furthermore, the these three attitudinal scales also had the highest percentages of respondents agreeing that these attitudinal scales were impacted by the CBIS system.

In terms of direction of communication, the three attitudinal scales examined were **organizational-wide, inter-departmental, and intra-departmental communication**. Organizational-wide communication refers to communications that go completely across the organization, to all the sub-units (branches). Inter-departmental communication refers to communication that crosses between two sub-units (branches). Intra-departmental communication refers to communication that does not cross the sub-unit's (branch's) organizational boundaries; it is communication that takes place within the sub-unit (branch).

In this case, the perception was that organizational-wide and intra-departmental communication were impacted the most. Each of these measures was significantly different from the perceived impact on the inter-departmental measure. A t-test showed no significant difference between the perceived impact on organizational-wide and

intra-departmental communication. One explanation for this result may be that the sub-units are technically independent of each other. Thus, the sub-units do not have a requirement to communicate with each other as much as they do within the sub-unit, or throughout the organization as whole. This would imply that for this organization, the focus for communication is intra-unit communication and organizational communication, while inter-unit communication is secondary.

Task-Relevant Content. The impact on message content agreed with the findings of Foster and Flynn. The respondents overwhelmingly agreed (71.6 percent) that most of their messages on the information system were task related (Table XII). According to Foster and Flynn, this is due to the fact that the information system allows for communication without the stylized protocol of face-to-face communications that develop in every organization (8:231). Thus, less time needs to be spent on the social chat, and more time can be spent focusing on task-relevant messages.

Research Question 3

> What impact, if any, does a CBIS have on organizational tasks in terms of efficiency, coordination and workload?

Tasks Impact. The three attitudinal scales for task performance used in this survey were task efficiency, task coordination, and task workload. Of these three measures, only task efficiency and task coordination were perceived as

being impacted by the information system. Statistically, there was no significant difference between the perceived impact on efficiency or coordination. Over 73 percent (Table XII) of the respondents agreed that the information system had improved their efficiency and simplified their task coordination.

An interesting, and seemingly contradicting result is that less than 24 percent of the respondents agree that the information system has reduced their task workload. In fact, these results are not contradictory with the perceived impacts on task efficiency and task coordination. It is possible that the respondents interpreted an increase in task efficiency as being able to coordinate tasks easier. This would explain the high pearson correlation coefficient between these two measures (0.7292). Furthermore, the ability to coordinate more efficiently does not mean that there is less work to do. It simply means you can get to do more work, not necessarily take on more work.

Research Question 4

> What impact, if any, does a CBIS have on organizational hierarchy in terms of the formal chain of command and the development of informal groups and networks that cross organizational boundaries?

Chain of Command. Past research on the impact of CBIS on organizational hierarchy suggest that due to the ease of access created by the electronic media, the traditional chain of command begins to deteriorate. Thus, it was

envisioned that communication directly with the Division Chief, by-passing the sub-unit chief, would become more prevalent than before the system was implemented. The results of the survey did not support this expectation.

The majority of the respondents disagreed that the CBIS had impacted the chain of command. In fact, only about 25 percent of the respondents agreed that they have used the information system to communicate directly with the Division Chief.

This low value can be interpreted in two ways. The first is that the traditional chain of command is holding well in light of the information system. Assuming that some of the 25 percent consists of members working on projects that have the Division Chief's vested interest, and some are senior members who perhaps through time have developed a direct communication channel with the Division Chief, than this number is not high. From another point of view however, the data shows that more than one in four of the respondents are by-passing, or perceive others are by-passing, their immediate supervisor to speak directly with the Division Chief.

Whether this number is too high or too low cannot be generalized to other organizations. However, for this case, each of the branch chiefs said the 25 percent number was not high. Their view was that these are probably the same 25 percent that would by-pass them anyway, with or without the

system. Since this is not a longitudinal study no judgment can be made as to whether this number has increased or decreased since the introduction of the information system.

Informal Groups and Networks. The Foster and Flynn study identified a trend away from position power and towards competence power though the information system. They identified that through the information system, members were more apt to identify other members within the organization with the skills and the knowledge to assist them.

The results of the survey indicate that over 60 percent (Table XII) of the respondents agree that they have met someone with similar skills and common interests through the information system. Apparently, one of the major benefits of the system has been the ability to communicate organizational-wide messages. This has made it easier for the various networks within the organization to get publicity throughout the organization. This publicity and open invitations to meetings has increased participation within the networks and as such, brought together members who otherwise may never have met.

Research Question 5

> Have any identifiable groups within the organization been impacted by the CBIS more than others?

A key aspect of the research was to identify what categories within each demographic group was impacted by the CBIS more than others. In this case, the results indicate a significant difference between some demographic groups when analyzed across the various attitudinal scales (Table XIV). To discuss the results, each demographic group will be addressed sequentially.

By Primary Job. When analyzed by primary job, only one attitudinal scale showed a significant difference ($p=.10$), task workload. The reason for just one difference may be that three of the categories within this demographic group had small sample sizes.

The significantly different categories by primary job within the task workload scale were the researchers and computer programmers (Table XV). While both agreed that the information system did **not** impact their task workload, the computer programmers overwhelmingly rejected the idea. One possible explanation for this could be that the computer programmers are already working directly on the mainframe computers, as such, they have no reason to transfer files through the information system. Thus, there would be less utility from the information system.

By Sub-Unit. In this case, the sub-unit that the members were assigned to made a significant difference in their responses. The group that was by far the most significantly different from the rest was HED. This is not

surprising since this office has a unique role within the organization. HED performs some classified work which is done in a secure area that has no access to the information system. Each member who works in this office has an account on the system, but needs to leave their work area to utilize the system. This major physical isolation would explain much of the findings.

The first significantly different category came from their perception of the CBIS impact on the **task efficiency** scale (Table XVI). Every sub-unit agreed that task efficiency had been improved except for HED. This could be explained by the previously mentioned reason. The members are not allowed to use the system to process any classified material. Thus, one would expect a small impact on their task efficiency. Yet at the same time they can use the system to coordinate unclassified material if they are willing to leave the vault area. This may explain why they are **not** significantly different from other groups under **task coordination**.

Another significant difference was between the perceptions of the on-site contractors and the HEG members regarding the impact on the **task workload** scale. This can be explained for two reasons. The first is that a large sub-group within the contractors are the computer programmers. As mentioned earlier, they are already working directly on the mainframe and have little need for the

information system. The second reason may be that the core technology thrust in HEG is workload assessment. Perhaps for this reason alone, HEG identified with the concept more than others. In fact, HEG was the only group to report an ability to handle more work due to the information system.

The third attitudinal scale that showed significantly different categories by sub-unit was **message content**. Recall that message content referred to the proportion of your messages that were task-relevant. Interestingly, the on-site contractors had the highest scores for task-relevant messages. They were significantly different from HED and HEF. A possible explanation is that while on-site contractors are users of the system, they do not feel at liberty to use the system for non-task messages as do the regular government members. In fact, a t-test between the government and the on-site contractors reveal that these two groups are significantly different from each other on this point ($p=.05$). The on-site contractors use the system for more task-relevant information than do the government workers.

By Age. The perceived impact across the attitudinal scales varied significantly by age. In fact, for seven of the 10 attitudinal scales there were significantly different groups identified (Table XIV). Each time the difference involved either group 3 or group 4. Group 3 consisted of ages 41-50 and group 4 consisted of 51-60.

For the impacts on task performance, the 51-60 age group was the only group to report no impact to **task efficiency or task coordination** (Table XX and Table XXI). The three other age groups reported a positive impact in task efficiency and task coordination. An explanation for this markedly different perception can be that the older people are just not using the system.

When examining the perception that the CBIS impacts the organizational hierarchy by either violating the traditional chain of command or by crossing organizational boundaries to meet new people, the 51-60 age group is significantly different from the others. On the violation of the **chain of command** (a vertical perspective), the 51-60 age group overwhelmingly rejects the idea. However, the 31-40 group appears to be less sure on this point (Table XXII). The difference between these two groups may be explained by the tenure of the older group. If you assume that age and tenure are correlated, than it may be that over time it has become accepted protocol for the older group to by-pass their immediate supervisor and talk to the Division Chief. Another possible explanation is that the older group does not use the system. As such, they may not be aware of the ease of electronic access to the Division Chief.

Another significant difference by age was the on the perceived impact to the attitudinal scale, **informal**. This scale measured their ability to meet new people with common

skills or interests across the organization (horizontal perspective). Again, it was the older group that reported no impact on their ability to meet new people, while the other groups reported some improvement (Table XXIII). This can be explained by the 51-60 group either not wanting to meet new people, or the 51-60 age group is not using the system. Even the 41-50 age group reported a significantly different positive impact.

Yet another significant difference by age appears in organizational communication. When asked about the perceived impact of the CBIS on **within the sub-unit communication and organization-wide communication**, the 51-60 age group was again significantly different from the others. While three of the four groups reported a significant increase in communication, the 51-60 age group reported just a minor increase (Table XXIV and Table XXV).

The final attitudinal scale showing significantly different groups by age is **message content**. Recall that this measure deals with the perception that most of your messages are task-relevant. Three of the four groups overwhelmingly agreed that their messages are mostly task-relevant, yet the 51-60 age group reports that the messages are **not** mostly task relevant (Table XXVI). It may be this final perception that is keeping the older group from using the system as much as they should.

By Information System Usage. This group divides the respondents by the number of times they log on to the information system. The goal was to see if there would be a different perception by those that use the system more. The only significantly different groups among the attitudinal scales by CBIS usage were **task efficiency and task coordination** (Table XIV).

Those groups that logged on at least once a day perceived a significantly different (p=.05) impact on task efficiency than those who did not log on at least once a day. The group that did not log on at least once a day was the only group that **did not** report an increase in task efficiency (Table XXVII). The implication is that if you use the system, than you will become more efficient. However, it may be for those that do not use the system, that their tasks are not conducive to information system applications.

The results are slightly different for task coordination. Each group reports an increase in ease of task coordination, but there is a significant increase in the perception for those who log on at least three times a day (Table XXVIII). It may be that those who log on three times a day are those who tasks require intensive coordination, but it may also be those members have learned to use the system are reaping the benefits of increased task coordination and task efficiency.

By Computer Usage. This demographic group was identified to see if people who used computers more often would perceive a greater impact on the attitudinal scales than those who did not. Interestingly, nine of the 10 scales show no significantly different categories.

The only significant difference was for those that use a computer for more than two hours a day versus those who use it for only an hour or two. The difference ($p=.1$) was in the attitudinal scale, **task workload** (Table 29). The one to two hour group overwhelmingly rejects the idea that the information system has impacted task workload, while the over two hour group is not sure either way.

An explanation for this may be that those members using the system for more than two hours are either doing 'number crunching' locally, then uploading to the mainframe, or else they are doing extensive word processing and transferring their files through the system. This ability to transfer data files would explain why the over two hour computer usage group does perceive some benefit in task workload. In fact, two of the branch chiefs reported the ability to transfer files as a major time saver for their employees that indirectly affects task workload. Apparently several searchers use the information system to get access to the computing power on the mainframe. Computing on the mainframe alone saves valuable time, which frees them up to do other things.

By Task Interdependence. This demographic group was identified to see if those people whose tasks were interdependent (dependent on each other) would perceive a greater impact on the attitudinal scales from the information system. As expected, those members that need to coordinate their work with their supervisor and at least three other peers (group 3) perceived the biggest positive impact on the attitudinal scales. Those members that coordinate with their supervisor only (group 4) perceived the least impact from the information system (Table 30 through Table 34).

The significant different categories were identified under the **task efficiency and task coordination** scales. The difference in task efficiency was between group 3 and group 4. This difference is most likely the result of the respondents interpreting improved task efficiency as being able to coordinate better. Thus, those members that coordinate with more than one other person would expect to see a bigger improvement in task efficiency. The difference in task coordination was the same as in task efficiency (group 3 and group 4), with the addition of another significant difference. There was a significant difference ($p=.05$) between those who have to coordinate with at least four people (group 3) and those who have to coordinate with either two or three people (group 2). There is no clear explanation why there is a difference between three and four

people, only to say that it is left to further study.

There were no significant differences on the perception of the organizational hierarchy scales and the only difference in the communication scales was for within-department communication. This result showed that those who coordinate with more than one person perceived a bigger impact on within the sub-unit communication. It is most likely the result of these people being required to coordinate with other people within the sub-unit. This finding demonstrates the importance of an information system for working groups of three or more.

By Coworker Location. This demographic group was identified to see what affect the location of coworkers had on the perceived impact of the information system on the 10 attitudinal scales (Table XIV). The presumption was that the further apart the coworkers, the greater the impact. This presumption was supported by two of the branch chiefs interviewed. The two chiefs that had their sub-units divided between buildings reported that the information system had a major impact on communication within the sub-unit.

The results of the survey show that the impact of location on task performance was more significant than any other demographic group. For those members with key coworkers within 25 feet, there was no perceived CBIS impact on **task efficiency** (Table XXXV). The category with

coworkers within 25 feet was significantly different from the category that had coworkers beyond 50 feet (p=.1) and those with coworkers located on another floor (p=.05). These identical differences also appeared for **task coordination and task workload** (Table XXXVI and Table XXXIX), with a few additional differences.

One of the additional differences for task coordination was that there was no statistical difference between the category with coworkers within 25 feet and the category with coworkers beyond 25 feet and within 50 feet (p=.05). These results indicate that the envelope of location for having **no impact** on task coordination has increased from the 25 feet seen in task efficiency to 50 feet for task coordination. Interestingly, for those members with coworkers beyond 50 feet, there was a significantly different perceived impact than the category with coworkers within 50 feet.

An additional difference for the perceived impact on **task workload by location** was that the category with coworkers within 25 feet overwhelmingly rejected the idea that the information system impacted their task workload, while the other categories were not sure of the impact. The evidence seems to indicate that in this case, there is no perceived impact on task performance for working groups with coworkers within 25 feet of each other.

In addition, when analyzed by location there were no significantly different categories among the attitudinal scales measuring the impacts on organizational hierarchy or organizational communication. The results of this analysis by location were similar to the overall results. None of the categories perceived an impact on the chain of command, and every category perceived a positive impact for both meeting new people through the system, and on organizational communication. An explanation is with an information system, your ability to communicate with others is independent of location if the CBIS works well as an electronic mail system.

The final difference by location was on the attitudinal scale, task content. The closer members physically were in the organization, the more likely their messages were not task-relevant. The category identifying that the majority of their messages were not task-relevant, was the category with the majority of coworkers within 25 feet. This is consistent with the previous results. If the members do not use the information system for task performance, than logically the remaining usage of the system will not be task-relevant.

Chapter Summary

This chapter discussed the implications of the survey data presented in Chapter IV. Each of the five research

questions was answered based on the survey and interview results. Chapter VI will summarize the conclusions presented in this chapter and make recommendations for future research.

VI. Conclusions and Recommendations

Overview

This chapter presents a summary of the key findings of this research effort. These case study findings, as discussed in Chapter III, are often difficult to generalize to other organizations. However, due to the conservative approach taken in the methodology, and the care taken to insure that this unit is representative of Air Force Laboratories, the researcher believes that these key findings ($p=.05$) are applicable to other similarly structured research and development organizations. Organizations which are structurally representative of the trends in future organizations.

Conclusions

1. The question of technological determinism has long been debated in the literature. While many argue that information systems do not impact organizations, the results of this research indicate otherwise. The survey analysis identified perceived impacts in six of the 10 attitudinal scales measured in this survey.

Clearly, the perception was that organizational communication and tasks were impacted the most by the information system. The evidence also shows that the perceived impact to organizational hierarchy is mixed.

Table XXXIX

Six Attitudinal Scales Perceived Impacted by CBIS

Attitudinal Scale
1. Task Efficiency
2. Task Coordination
3. Departmental Communication
4. Interdepartmental Communication
5. Organizational-Wide Communication
6. Task-Relevance of Message

2. Organizational communication was clearly impacted by the information system. The respondents overwhelmingly agreed that communication was better within the sub-unit, between sub-units, and organization-wide. The results indicate that the biggest perceived impact was for organization-wide communications. The respondents believe it is now easier for messages to get distributed promptly throughout the organization from the top-down and from the various networks within the organization.

3. Organizational tasks were impacted in terms of task efficiency and task coordination. The respondents perceived that the information system made them more efficient and made the coordination of their tasks much easier. Interestingly, these findings did not impact their perception on task workload. Though the respondents believed they were now more efficient and could coordinate easier, they did not feel the system enabled them to take on

more work. The implication is that the system had just a minor impact on organizational task performance.

4. The results of the perceived impact on organizational hierarchy were mixed, and can be interpreted in several ways. The majority of the respondents perceived no impact on the chain of command (vertical). Yet, 25 percent reported by-passing their immediate supervisor with the information system. Whether 25 percent is high or low needs to be answered on a case by case basis. For this study, the immediate supervisors did not see it as a problem. They perceived it as a function of their supervisor's management style, and the identification of employees who would by-pass them with or without an information system. In addition, the perceived impact to the horizontal boundaries within the organization were also mixed. Over 60 percent of the respondents reported meeting new people outside their sub-unit through the information system. Yet the mean of their responses indicated that they appeared ambivalent to any impact.

5. The final aspect of this study was to determine if any demographic groups within the organization perceived a significantly different impact from the system than other groups. Data was analyzed by primary job, age, frequency of information system usage, frequency of computer usage, location of coworkers, the sub-unit assigned to, and by the interdependence of their task. The results identified

several demographic groups that perceived a significantly different impact from the CBIS at the p=.05 level.

There were no significant differences among the various types of jobs at the .05 level. Administrators, engineers, and scientist all had the same perception of the information system impacts. This may be due to the small sample sizes in several of the categories.

The difference in age was with the oldest age category, 51-60 years. Each of the younger categories perceived a positive impact on organizational communication and organizational tasks, yet the oldest category perceived none. In addition, each of the younger categories reported that most of their messages were task related, while the older category believed that most of the messages were not task-relevant.

The significantly different categories appeared under task efficiency and task coordination. For task efficiency, the results show that every category showed a positive impact on task efficiency, except the one that reported using the system less than once a day. The implication is that if you can get your people to use the system, they will perceive that it is helping them on the job. For task coordination there was a significant difference for respondents that logged on more than twice a day versus those that did not. The explanation may be that those

members who have tasks that require more coordination need to log on to the system more often. This implies a correlation or an association between the number of log on's and the number of required coordinations for task performance.

By computer usage there was no significantly different categories across the attitudinal scales at the .05 level. Interestingly, the amount of time spent working on a computer is independent of one's perception of the impact of the information system on the organization.

The responses from members that were required to coordinate their work with more than 3 other individuals was significantly different from the respondents who had to coordinate with less than two other people. The former reported a significantly greater impact than the latter, though both reported a positive impact.

By far, the biggest significant impact was by location. For organizations that are forced to have key coworkers physically separated, the benefits can be enormous. Every category that had coworkers more than 25 feet away reported a benefit from the system, and the further separated the coworkers, the higher the reported benefit. Another finding showed that the further away the coworker, the more likely the task messages were to be task-relevant. The implication is that the closer the coworkers are, the less benefit from the information system.

For the most part, the results from this case study are consistent with past studies. The evidence suggests that organizational communication and tasks will inevitably be impacted by the implementation of an information system. However, the impact on organizational hierarchy was not as clear as reported by Foster and Flynn. Rather, the results are more in line with the results of Markus and Robey who say that for the most part there will be no change.

The findings by demographic group identified some key issues that should be considered when seeking to increase the utility of or designing an information system. Specifically, extra attention needs to be paid to older age groups that may not be as willing to use the system. In addition, the evidence suggests that if members can be convinced to use the system at least once a day, they will perceive a positive impact on organizational communication and tasks. Furthermore, the amount of time employees spend computing has no bearing on their perception of the information system impact. Also, the greater the interdependence among employee tasks, the more likely a positive impact will be perceived from the system. And finally, the most significant impact was from coworker location. When separated by more than 50 feet from coworkers, the information system was perceived to have a greater impact on organizational tasks. This result is

consistent with a related finding, that the closer an employee is to his coworkers, the more likely that system messages are not task-related and vice-versa.

Finally, the perception that paperwork has not been reduced by the impact of the information system is not surprising. Through follow-on interviews it became apparent that not only in this organization, but many organizations are not using the information systems to print out government forms. Though the information is being exchanged through the system, each party involved is still required to produce the mandatory hard copy forms. Furthermore, key documents need to be physically coordinated, rather than using an electronic signature system. Yet surprisingly, the feeling among the the sub-unit chiefs was that paperwork was most definitely being reduced. The difference may stem from the type of paperwork. The chiefs perform administrative work which is passed on down to the employees, while the employees are usually the ones who need to respond to a suspense in what may be a pre-defined format. Thus, the chief saves paperwork when coordinating with all of his employees, while the employee only coordinates with his supervisor.

General Recommendations

Clearly, information systems are perceived to have a positive impact on organizational communication and

organizational tasks. As discussed earlier, care must be taken to insure that the information system is matched to the organizational structure.

Furthermore, not just the organizational structure, but the user requirements of the work force needs to be analyzed in order to maximize the benefit of the information system. Any system, if not meeting the user's requirements, will not be used. The top user requirement for this organization, identified in Part III of the survey, is for on-line library/literature search capability. The organization has already taken steps to add this capability.

In addition, in order to get the benefit of paperwork reduction, the government must begin to encourage the use of electronic forms. In this way, forms can be transmitted through the system reducing the need for hard copies. Another step that could be taken is that of electronic signatures. When coordinating documents through the system, the need for initialing is by-passing the benefit of the information system. By electronically initialing a document, there is no need for a hard copy.

Recommendations for Further Study.

These results are from a single case study, but the overall results are for the most part consistent with the literature. The analysis by demographic groups is somewhat unique. Therefore, this study should be considered the first step in a survey of all Air Force research and

development Laboratories. The follow-on study would could verify the researchers belief that these significant findings can be generalized to any Air Force research and development organization. In addition, the significantly different categories among the various demographic groups can be verified. This can be supplemented with a more comprehensive search for other significantly different categories among other demographic groups.

Furthermore, a similar study done in the commercial sector would lend itself to identifying the differences, if any, between the commercial sector and the government laboratories. These differences could than be examined to see if there are any steps the Air Force could take to further improve the effectiveness of its computer based information systems.

Appendix A: CBIS Impact Survey

Monday 22 May 1989

REPLY TO
ATTN OF: HEC (Capt Sarmiento)

SUBJECT: FALCON Impact and Requirements Survey

TO: FALCON Users

1. This FALCON survey is part of an AFIT Research Project that is being sponsored by the Human Engineering Division. Please take about 15 to 20 minutes to answer the survey.

2. The primary objective of the survey is to identify what impact the FALCON has had on organizational communication, organizational tasks, and organizational hierarchy. The secondary objective is to collect your comments on the FALCON System itself. Your inputs will be combined with others and used to make the FALCON a better system for everyone. The data gathered will become part of an AFIT Research Project concerning the impact of information systems on research and development organizations.

3. Your participation is completely voluntary. Furthermore, all responses will be kept anonymous. I ask that you please return the survey by Wednesday, 24 May 1989. If you have any questions, please contact me at ext. x55435.

Thank You,

GEORGE H. SARMIENTO, CAPT, USAF
AFIT/LSG (GSM/89S)

PART I. This part asks for background information. These questions are designed to provide us with demographic information about our respondents. Please check only one answer on the answer sheet.

1. How would you classify your current primary job?

(1) Administrative/Clerical
(2) Technician
(3) Engineer
(4) Researcher/Scientist
(5) Computer Programmer
(6) Other

2. To which organization are you currently assigned?

(1) HEA
(2) HED
(3) HEG
(4) HEF
(5) HEX
(6) SRL
(7) OTHER

3. What is your age group?

(1) 20-30
(2) 31-40
(3) 41-50
(4) 51-60
(5) Over 61

4. How often do you log on to the FALCON?

(1) Average less than once a day
(2) 1 or 2 times a day
(3) 3 or 4 times a day
(4) At least 5 times a day
(5) Log on once then stay logged on all day
(6) Not at all

5. On average, how much time do you spend on a computer a day?

(1) up to a 1/2 hour a day
(2) more than a 1/2 hour, but less than 1 hour a day
(3) more than 1 hour, but less than 2 hours a day
(4) more than two hours a day
(5) none at all

6. Your primary work is usually coordinated with

(1) your supervisor only
(2) your supervisor and 1 or 2 fellow workers
(3) your supervisor and more than 2 fellow workers
(4) no one

PART I (Continued). This part asks for background information. The questions are designed to provide us with demographic information about our respondents. Please check only one answer on the answer sheet.

7. "MOST" of the people you work with on your current tasks are located

   (1) within 25 feet of your work area.
   (2) beyond 25 feet, but within 50 feet of your work area.
   (3) beyond 50 feet of your work area, but on same floor.
   (4) on another floor or another building.

8. How long have you been assigned to the Human Engineering (HE) Division?

   (1) Less than 2 years (after FALCON implementation)
   (2) More than 2 years, but less than 3 years
   (3) More than 3 years

PART II. This part contains statements about the impact of the FALCON on organizational communication, organizational structure, and task performance. For each item, use the following scale to indicate how much you agree or disagree with each statement.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	1	1	1	1
1	1	1	1	1
1	2	3	4	5

9. Using the FALCON has reduced the amount of administrative paperwork required to perform my tasks.

10. The FALCON has made the accomplishment of my tasks more efficient.

11. Using the FALCON I have been able to access the Division Chief without going through the Branch Chief.

12. The FALCON makes communication 'within' the Branch easier.

13. The FALCON has made the distribution of Division-wide messages easier.

14. The FALCON has made it easier to 'coordinate' my tasks.

15. The amount of paperwork required to perform my tasks has been greatly reduced by the FALCON.

PART II (Continued). For each item, use the following scale to indicate how much you agree or disagree with each statement.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	1	1	1	1
1	1	1	1	1
1	2	3	4	5

16. Most of my FALCON communications are "not" task related.

17. Through the FALCON I have met people, outside of my branch, with common interests and skills.

18. The FALCON has made communication between branches easier.

19. Having to coordinate task related issues with others is easier because of the FALCON.

20. Most of my communications on the FALCON are task oriented.

21. I have developed personal contacts and informal networks through the FALCON that I would not have normally made.

22. Efficiency wise, the FALCON has "NOT" had a big impact on the performance of my tasks.

23. Concerning task related issues, the Division Chief has used the FALCON to contact me directly (bypassing the branch chief).

24. The FALCON has helped me meet people who are knowledgeable in an area that I am interested in.

25. Use of the FALCON has made me more efficient in my work.

26. Using the FALCON has reduced my workload.

27. The FALCON has "not" reduced the amount of paperwork needed to perform my tasks.

28. Using the FALCON, it appears others communicate directly with the Division Chief without coordinating with the Branch Chief.

29. Communication between branches is better with FALCON.

30. My organization provides all the necessary information for me to do my job effectively.

PART II (Continued). For each item, use the following scale to indicate how much you agree or disagree with each statement.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	1	1	1	1
1	1	1	1	1
1	2	3	4	5

31. My work group is usually aware of important events and situations.

32. The people I work with make my job easier by sharing their ideas and opinions with me.

33. People in my work group are never afraid to speak their minds about issues and problems that affect them.

34. My ability to handle more work has increased because of the FALCON.

35. My workload has decreased noticeably with the implementation of the FALCON system.

36. Coordination of tasks is "NOT" easier with the FALCON since everyone still likes to see hard copies anyway.

37. The FALCON has made it easier for me to join groups (networks) that I normally would "NOT" have known about.

38. Within the Branch, communication has been greatly enhanced by the FALCON.

39. Administratively, Division-wide communication has been greatly enhanced with the FALCON.

40. The content of my FALCON messages are for the most part task related.

Please answer the following three questions relative to communications "prior" to the implementation of the FALCON.

41. The FALCON has increased the absolute number of communications I would otherwise make between branches.

42. The FALCON has increased the absolute number of communications I would otherwise make within the branch.

43. The FALCON has increased the absolute number of communications I would otherwise make Division-wide.

PART IIIa. This part contains statements concerning FALCON hardware, software, and training issues. For each item, use the following scale to indicate how much you agree or disagree with each statement.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	1	1	1	1
1	1	1	1	1
1	2	3	4	5

44. Formal training on using the FALCON has been adequate.

45. Logging on to the FALCON is a problem in the mornings.

46. Once on the FALCON, the system response time is more than adequate.

47. I have heard of TEX, TPU, or SDA.

48. I have used the FALCON to transfer files.

49. Using the FALCON I have accessed the software packages available on the VAX.

50. My desktop computer is powerful enough to meet my needs.

51. With the laser printers throughout HE, I no longer need a printer in my office.

52. Access to ASD Procurement through the FALCON would help.

53. The FALCON User's Guide is adequate for my needs.

54. The data and statistical analysis software now on the FALCON is adequate for my needs.

55. I know of sensitive information (e.g. source selection, privacy act, classified) being stored on the FALCON.

56. I would like to have the capability of storing sensitive information on the FALCON.

57. I am TDY frequently and could benefit from having an HE WATTS number to call back to FALCON.

PART IIIb. Please rank the following capabilities from 1 to 6 in terms of the "most critical" to your work (1 = most critical, 6 = least critical).

58. _____ Statistical analysis

59. _____ On-line library/literature search

60. _____ Preparing visual aids or business/scientific graphics

61. _____ Project management tools.

62. _____ Calendar of official/formal Branch/Division activities.

63. _____ Improved DDN access.

PART IIIc. Please rank the following capabilities from 1 to 6 in terms of the one you would "most frequently use" (1 = most frequent, 6 = least frequent).

64. _____ Statistical analysis

65. _____ On-line library/literature search

66. _____ Preparing visual aids or business/scientific graphics

67. _____ Project management tools.

68. _____ Calendar of official/formal Branch/Division activities.

69. _____ Improved DDN access.

PART IV. Open ended questions. Please respond to the following questions in the space provided below.

70. What impact has the FALCON had on communication within the Division?

---

71. What impact has the FALCON had on the performance of your tasks?

---

72. What do you see as the main impact, if any, of the FALCON on HE?

---

73. What is your biggest problem or concern with the FALCON as it stands today?

---

74. In order to meet your future needs, what changes or additions would you like to see to the FALCON system?

---

75. What type of information, stored in a database, would save you the most time and energy?

Please return this questionnaire to the Branch Secretary.

THANK YOU FOR YOUR HELP!

Appendix B: Interview Questions

1. Name:

2. Rank/Grade:

3. Organization:

4. Do you perceive that the Falcon (CBIS) has had an impact on organizational communication?

5. Do you perceive that the Falcon (CBIS) has had an impact on organizational tasks?

6. Do you perceive that the Falcon (CBIS) has had an impact on the organizational hierarchy?

7. Has it affected your management style?

8. Survey results indicate that approximately 25 percent of the members admit to using the system to communicate directly with the Division Chief. Do you feel this number is high or low?

9. Do you perceive that the FALCON (CBIS) has helped reduce paperwork? Why?

(IF YES TO QUESTION 9 PROCEED)

10. Regarding the reduction of paperwork, only 30 percent of the respondents agree that paperwork has been reduced. Do you feel this number is high or low?

Appendix C: Government Versus Contractor Breakout

This appendix contains a government versus contractor breakout for the survey responses. Note that the mean scores reflect a 5-point Likert Scale score. The higher the score, the more the group agrees with the perceived impact.

	Government			Contractor		
Attitudinal Scale	N	Mean	Std Dev	N	Mean	Std Dev
Task Efficiency	36	3.55	0.960	31	3.51	1.018
Task Coordination	36	3.56	0.776	31	3.57	0.657
Task Workload	36	2.82	0.834	31	2.46	0.718
Chain of Command	34	2.88	0.906	31	2.72	0.689
Informal	35	2.59	0.844	31	2.61	0.755
Departmental	36	3.89	0.667	31	3.80	0.734
Interdepartmental	36	3.57	0.579	31	3.66	0.658
Organizational	36	4.28	0.485	31	3.90	0.800
Paperwork	36	2.90	0.979	31	2.88	0.972
Message Content	36	3.39	1.047	31	3.85	0.802

Bibliography

1. Allen, Thomas J. Managing the Flow of Technology. Cambridge: Massachusetts Institute of Technology, 1977.

2. Bjorn-Andersen, Niels and others. Managing Computer Impact: An International Study of Management and Organizations. Norwood NJ: Ablex Publishing Company, 1986.

3. Daft, Richard L. and Richard M. Steers. Organizations: A Micro/Macro Approach. Glenview IL: Scott, Foresman, and Company, 1986.

4. Daft, Richard L. and Robert H. Lengel. Information Richness: A New Approach to Managerial Behavior and Organizational Design. Contract N00014-83-C-0025. Arlington VA: Office of Naval Research, May 1983 (AD-A128980).

5. Davis, Gordon B. and Margrethe H. Olsen. Management Information Systems: Conceptual Foundations, Structure, and Development. New York: McGraw-Hill Book Company, 1985.

6. Drucker, Peter F. "The Coming of the New Organization," Harvard Business Review, 66: 45-53 (January-February 1988).

7. Emory, C.W. Business Research Methods. Homewood IL: Richard D. Irwin, Inc., 1985.

8. Foster, Lawrence W. and David M. Flynn. "Management Information Technology: Its Effects on Organizational Form and Function," MIS Quarterly, 8: 229-235 (December 1984).

9. Gashler, Paul B. Impacts of End-User Computing on the Structure of Contemporary Administrative Organizations MS Thesis. Naval Postgraduate School, Monterey CA, June 1988 (AD-A199280).

10. Huber, George P. "The Nature and Design of Post-Industrial Organizations," Management Science, 30: 928-951 (August 1984).

11. Lee, Alan S. "A Scientific Methodology for MIS Case Studies," MIS Quarterly, 13: 32-45 (March 1989).

12. Leifer, Richard. "Matching Computer-Based Information Systems with Organizational Structures," MIS Quarterly, 12: 63-73 (March 1988).

13. Leifer, Richard and Capt Tom Triscari. "Organizational Design and Computer-Based Information Systems Design: Basic Conformations." Working Paper, School of Management, Rensselear Polytechnic Institute, 1987.

14. Madnick, Stuart E. "Introduction: Perspectives on the Effective Use, Planning, and Impact of Information Technology," Sloan Management Review: The Executive Bookshelf, edited by Stuart E. Madnick. New York: Oxford University Press, 1987.

15. Markus, M. L. and Daniel Robey. "The Organizational Validity of Management Information Systems," Human Relations, 36: 203-225 (March 1983).

16. Ott, Lyman. An Introduction to Statistical Methods and Data Analysis (Third Edition). Boston: PWS-Kent Publishing Company, 1988.

17. Owen, Darrell E. "Information Systems Organizations: Keeping Pace with the Pressures," Sloan Management Review: The Executive Bookshelf, edited by Stuart E. Madnick. New York: Oxford University Press, 1987.

18. Robey, Daniel. "Computer Information Systems and Organization Structure," Communications of the ACM, 24: 679-686 (October 1981).

19. Robey, Daniel. "Implementation and the Organizational Impacts of Information Systems," Interfaces, 17: 72-84 (May-June 1987).

20. Rockart, John F. "The Changing Role of the Information Systems Executive: A Critical Success Factors Perspective," Sloan Management Review: The Executive Bookshelf, edited by Stuart E. Madnick. New York: Oxford University Press, 1987.

21. Specht, Pamela and Daniel Robey. Organization Design and Information System Design: An Integrative Model Based on Information Processing Requirements. Unpublished report. College of Business Administration, University of Nebraska-Omaha.

22. Steel, Robert P. Class lecture in ORSC 661, Making Sense of Research Data. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, April 1989.

23. Triscari, Thomas A. Class handout distributed in SMGT 650, Management Information Systems. School of Systems and Logistics, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, February 1989.

24. Tushman, Michael L. and David A. Nadler. "Information Processing as an Integrating Concept in Organizational Design," Academy of Management Review, 3: 613-624 (July 1978).

25. Zmud, Robert W. Information Systems in Organizations. Glenview IL: Scott, Foresman and Company, 1983.

Vita

Captain George H. Sarmiento [redacted] He then attended the University of Dayton where he received the Degree of Bachelor of Science in Electrical Engineering in April 1983. A year later he received a commission in the USAF through Officer Training School at Lackland Air Force Base, Texas. He was then assigned to the Human Engineering Division of the Harry G. Armstrong Aerospace Medical Research Laboratory located at Wright-Patterson Air Force Base, Ohio. While there he served as a display systems engineer in the Visual Display Systems Branch. During this time he attended the Central Michigan University extension program and received the degree of Master of Science in Human Resource Administration in December, 1986. In May, 1988 he entered the School of Systems and Logistics at the Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFIT/GSM/LSY/89S-33	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION School of Systems and Logistics 6b. OFFICE SYMBOL (If applicable) AFIT/LSY	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Air Force Institute of Technology Wright-Patterson AFB OH 45433-6583	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
AN ANALYSIS OF THE IMPACTS OF COMPUTER-BASED INFORMATION SYSTEMS ON RESEARCH AND DEVELOPMENT ORGANIZATIONS

12. PERSONAL AUTHOR(S)
George H. Sarmiento, M.S., Capt, USAF

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
MS Thesis	FROM _____ TO _____	1989 September	120

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	Information Systems; Behavioral Science; Information Processing; Scientific Organizations
05	01		

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Thesis Advisor: Major Thomas Triscari
Associate Professor of Systems Management
Department of Systems Aquisition Management

Approved for public release: IAW AFR 190-1.

Larry W. Emmelhainz

LARRY W. EMMELHAINZ, Lt Col, USAF 14 Oct 89
Director of Research and Consultation
Air Force Institute of Technology (AU)
Wright-Patterson AFB OH 45433-6583

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
Major Triscari, Assoc. Professor	(513) 255-4845	LSY

Today, more and more organizations are turning towards computer based information systems to help them deal with the complexities brought on by the Information Society. These computer based information systems are impacting all levels of the organizations.

This research effort was a study involving the impact of a computer based information system at a USAF research and development organization. A key aspect of the study was to attempt to identify if any demographic groups perceived themselves to be impacted by the CBIS more than others.

The results show that a CBIS was perceived by the respondents to impact organizational communication and organizational tasks. Communication within sub-units, between sub-units, and throughout the organization were perceived to be enhanced. In addition, the findings indicate that those members willing to use the system perceived a positive impact on task efficiency and task coordination. Interestingly, the respondents reported that the information system had not reduced their task workload. However, the findings show that the impacts to the organizational hierarchy were mixed. Over 25 percent of the respondents reported bypassing the formal chain of command and over 60 percent reported meeting new people through the information system.

The results of this study demonstrate the importance of understanding the theory of organizations as information processors, and some of the potential impacts of computer based information systems in research and development organizations. Most importantly, it is an attempt to identify those groups that may themselves be impacted the most by the information systems.